The Expansion of Chinese Construction Companies in the Global Market

By

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Abstract

Chinese contractors are increasingly playing a significant role in the global construction market. This thesis provides a comprehensive study of the global expansion of Chinese construction companies as a result of Chinese open-door policies, by describing their developments from 1950 to 2008, highlighting their achievements, and identifying the main constraints preventing them from playing a more effective and efficient role in the global construction market. The development of Chinese construction companies in the global market was divided into three periods: the first period from 1950 to 1978, the second period from 1979 to 2001, and the third period from 2002 to 2008. In each period, the autonomy of Chinese construction companies, along with their achievements and problems were studied. Besides, the new business environment after accession to the World Trade Organization (WTO) and the analyses on Chinese foreign economic cooperation and on the top Chinese contractors (Top CC) using the data since 1979 were conducted. The results of this thesis can help the U.S. construction companies become more familiar with the Chinese construction companies and therefore more competitive in the global construction market.

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Table of Contents

List of Tables

List of Figures

Chapter 1

Introduction

1.1 Background

The development of Chinese construction enterprises in the global market can be traced back to 1950s when the Chinese government provided economic and technical aid to other developing countries (Low and Jiang, 2003). During this period, the international involvement of Chinese construction firms was mainly for financial aid projects in some developing countries with funds provided by the Chinese government. The Chinese construction industry started to change in the early 1980s with the introduction of economic reforms and the open-door policies. On August 13, 1979, Chinese State Council introduced an Act in which Chinese specialized companies were allowed to invest in other countries (Low and Jiang, 2003). At the central government level, the government agencies started to introduce regulations to set the basic ground rules. At the enterprise level, the entities were gradually given flexibility to operate as commercial entities (Chen, 1998). Since implementation of the open-door policies in 1978, the construction industry has rapidly grown to become the third among the five major sectors of the economy (Chan and Chan, 2002), and has been transformed with the introduction of the market economy. Since the early 1990s, some of the largest state owned construction enterprises have gained experience in the international market. Subsequently, provincial-level and some other regional companies were allowed to obtain licenses for contracting overseas. By 1994, several of the more established Chinese construction companies were shaped up. Thereafter, the more profitable enterprises were encouraged to list in the stock market following a strict evaluation exercise, which means they would no longer be protected by the government (Low and Jiang, 2003). After Chinese

accession to the World Trade Organization (WTO), more than 1,600 Chinese companies have the required qualifications to carry out international engineering and construction contracts (Reina and Tulacz, 2004).

Many studies have been completed on the subject of Chinese construction industry. At the industry level, Jefferson et al. (1992) investigated Chinese fast-growing collective industries and developed a "quasi-frontier" estimation procedure which seems appropriate for comparisons of total factor productivity based on Chinese industrial data. Ofori (1993) discussed the reasons for the lack of advancement in the construction industries of the developing countries, including Asian and African countries which are the largest markets for Chinese contractors, and proposed measures which can be taken to improve upon the situation. He also suggested the formation of a global body dedicated to the promotion, coordination and dissemination of works. Chen (1998) provided a comprehensive study of the development of Chinese construction industry as a result of the economic reforms by describing the current status of the construction industry in China, highlighting its achievements, and identifying the main constrains preventing the industry from playing a more effective and efficient role in the country's economic development. Raftery et al. (1998) illustrated the dilemma in Asian market with the case of Japan as a world leader in international construction services. They believed that Japan's dominance apparently came through the orchestration of industrial and corporate policies, implemented in a highly regulated and protected domestic market; while, construction industries in other Asian economies (such as China) would have to leapfrog in technology, finance and management know-how (e.g. through joint ventures with construction companies in developed countries) before they could become formidable powers in an environment that had become much more global, more de-regulated, more open and more competitive than before. Based on a structured questionnaire survey, Zeng

et al. (2003) concluded that the government should take the lead in encouraging training, providing financial support, and improving the legal framework to promote ISO 14000 for the Chinese construction industry. Xu et al. (2005) believed that compared with the construction industries in the United States, Japan, and the U.K., the construction industry in China was less developed in its legal framework, industrial structure, technological level, and international market share. They gave a timely evaluation of the post-WTO Chinese construction industry and proposed a model for its development. The model might serve the needs of academics, Chinese construction policymakers, construction enterprises, design institutes, and foreign contractors. Huang and Bai (2010) presented an overview to the development of the Chinese construction industry after the Culture Revolution, details the reform process in terms of administrative framework, laws and regulations, and procurement methods; analyzes its growth trends in different time periods based on statistical data on economic indicators, employees and equipment, and market structure; compares the characteristics of the Chinese and U.S. construction industries.

At the enterprise level, Low and Jiang (2003) conducted an analysis of 35 Chinese contractors on the list of the Top 225 International Contractors in 2000 to evaluate their achievements using the following performance indicators: International Revenue/Total Revenue, International Business Distribution, Overseas Management Structure, Involvement in Specialized Fields, and Overall Index of Internationalization. The analysis also identified the top ten Chinese contractors who are truly global in outlook. Ofori (2003) compared the international performance of construction firms (such as China State Construction & Engineering Corporation) in middle- and low-income countries, including China, and examined the applicability of various analytical frameworks to international construction. Pheng et al. (2004) compared the performance of top

British and Chinese contractors based on the OLI+S model, which incorporated the ownership (O), location (L), internalization (I) and specialty (S) factors. Their study also suggested that the international involvement of top British contractors has declined from the peak in 1996, while that of the top Chinese contractors has grown steadily since the 1980s. Alden and Davies (2006) investigated the rise of Chinese multinationals in Africa by, first, examining the content and conduct of Chinese firms, second, their linkages to government strategy and, finally, assessing their impact on Africa. Zhang and Liu (2009) provided the related Strengths-Opportunities (SO), Weaknesses-Opportunities (WO), Strengths-Threats (ST) and Weaknesses-Threats (WT) strategies for Chinese contractors, on the basis of explaining the construction market environment in Southeast Asia, analysis of the Chinese contractors' strengths, weaknesses, opportunities and threats when expanding Southeast Asia construction market, with the method of the Strengths-Weaknesses-Opportunities-Threats (SWOT) analysis. Zhao et al. (2009) employed a SWOT analysis in combination with qualitative research to analyze the situation of Chinese contractors in the international market. Cheng and Zhang (2010) believed that with the spread of economic globalization, competition for international engineering and construction projects is becoming increasingly intense, thus Chinese companies will have to face this competition within the terms of WTO.

Besides, Shen et al. (2001) established a risk significance index to show the relative significance among the risks associated with the joint ventures in the Chinese construction procurement practice. Real cases were examined to show the risk environment faced by joint ventures. They also investigated practical applications of risk management in the business of joint ventures. Kwan and Ofori (2001) examined whether Chinese culture can facilitate partnering implementation in Singapore's construction industry through a postal survey on

Chinese-owned large contractors in Singapore. The study showed that Chinese contractors understand their culture as comprising certain core values that influence the operations of their businesses and their relationships with others, and that Chinese culture aids the implementation of partnering. Based on a survey carried out in Hong Kong, Chan and Chan (2002) investigated the phenomenon of disintegrating professional boundaries in the "international" practice system which serves as a reflection on the development of construction professionals in China. The investigation shows that construction professionals should critically re-examine their professional skills in their traditional domains. Chan and Chan also believed that at this juncture, China can make use of the opportunity to establish a new model for itself. Chui and Bai (2009) analyzed and compared general conditions of construction contract that commonly used in the U.S. (AIA-A201) and China (GF-1999-0201). Their research aimed to address business practice differences between the two countries, identify appropriate content that could be adopted by the U.S. firms, provide guidelines for future development of general conditions in China, and offer means of decision-making for American companies in implementing of general conditions in China. Mayo and Liu (1995) presented a discussion of the Chinese reform agenda for the overall Chinese economy, and specifically for the Chinese construction industry. They also described the reform agenda of the Chinese construction industry for the rest of the 1990s, and questioned if the government would be able to meet those goals.

All of these researchers have studied the Chinese construction companies in the global market from different aspects and time periods. While these studies are either out of date or only focused on a particular area, none of the studies have been found to analyze the expansion of Chinese construction companies in the global market in a comprehensive way. Thus, this thesis is written to fill the knowledge gap on this subject.

1.2 Thesis Organization

This thesis includes the following charters:

Chapter 1 Introduction: The thesis starts with this introduction chapter which presents the research background and a brief description of the thesis organization.

Chapter 2 Research Objectives and Methodology: This chapter outlines the objectives of this research and the methodology used in the data collection and data analysis.

Chapter 3 Literature Review: This chapter presents the finding of a comprehensive literature review in terms of the autonomy of Chinese construction companies along with their achievements and problems and the new business environment after accession to the WTO. The literature review was divided into three periods: the first period from 1950 to 1978, the second period from 1979 to 2001, and the third period from 2002 to 2008.

Chapter 4 Data Collection: This chapter describes various data collection issues including data source, terminology, data processing method, and collected datasets.

Chapter 5 Data Analysis on the Global Expansion of Chinese Construction Companies: Due to the shortage of comprehensive and continuous data from 1950 to 1978, the first period mentioned in literature review is not covered in the data analysis. In fact, prior to the 1970s, the international involvement of Chinese construction firms was mainly for financial aid projects in some developing countries with funds provided by the Chinese government. These projects did not technically constitute part of the international construction market. Thus, only two periods (1979 to 2001 and 2002 to 2008) were chosen for data analysis and results are presented in this chapter.

Chapter 6 Conclusions and Recommendations: Finally, this chapter presents conclusions drawn from the study and recommendations to the U.S. construction companies and future research.

Chapter 2

Research Objectives and Methodology

2.1 Objectives and Scopes

The major objectives of this study were to investigate the global expansion of Chinese construction companies after 1979 (the Culture Revolution) and to project their future growth. The scopes of this thesis are limited to Chinese foreign economic cooperation from 1979 to 2008; the investigated fields include the construction projects, the labor services, the design consultation and the performance of the top Chinese contractors.

Although Chinese contractors are increasingly playing a significant role in the global construction market, relatively few studies have been completed on their historical background and competition in the international arena. Thus, the result of this study could be utilized to assist U.S. architectural, engineering and construction companies to become more familiar with Chinese construction companies, and thus be more competitive in the global market.

2.2 Methodology

The research objectives were achieved through the following steps:

1. Literature review: A comprehensive literature review was conducted to understand the previous studies on the foreign economic cooperation of Chinese construction companies. The review findings are presented in Chapter 3 of this thesis. The literature review was divided into three periods: the first period from 1950 to 1978, the second period from 1979 to 2001, and the third period from 2002 to 2008.

2. Data collection: Statistical data on Chinese foreign economic cooperation from 1979 to 2008 were obtained from the China Statistical Yearbooks from 1996 through 2009. The statistics cover construction projects, labor services and design consultation. The data on the top Chinese contractors from 2002 to 2008 were collected from Engineering News Record yearly reports of the Top 225 International Contractors. All collected data were compiled to spreadsheets for data analysis.

3. Data analysis of the global expansion of Chinese construction companies: Microsoft Office Excel 2007 was used to analyze statistical data and to predict future trend. The fitting degree between the estimated value and the corresponding factual data was examined by R squared value. Tables and figures were generated to show the global expansion of Chinese construction companies in each year. In addition, all data analysis in this thesis did not take currency inflation into account.

4. Conclusions and recommendations: Primary findings include the features and the changing trend of Chinese economic cooperation with foreign regions, the performance of the top Chinese contractors and the projection of the future expansion of Chinese construction companies. Recommendations were provided to U.S. construction companies that conduct business in the global market. In addition, recommendations were given for future research on this subject.

Chapter 3

Literature Review

The development of Chinese construction enterprises in the global market can be traced back to the 1950s when the Chinese government provided economic and technical aid to other developing countries. From 1950s, in order to achieve the objective of ‘‘liberation and independence of brotherhood countries in the third world,’’ the Chinese government began to provide economic and technical aid to other developing countries. Until the implementation of the open-door policies in 1978, the construction industry started to be transformed with the introduction of the market economy. Since the early 1990s, some of the largest state owned construction enterprises have gained experience in the international market. Subsequently, provincial-level and some other regional companies were allowed to obtain licenses for contracting overseas (Low and Jiang, 2003). After Chinese accession to the WTO, more than 1,600 Chinese companies have the required qualifications to carry out international engineering and construction contracts, but the dominant ones are large state-owned enterprises (Reina and Tulacz, 2004).

Based on a review of previous studies, the historical penetration of the international construction market by Chinese enterprises can generally be divided into three periods: the first period from 1950 to 1978, the second period from 1979 to 2001, and the third period from 2002 to 2008.

3.1 The First Period from 1950 to 1978

3.1.1 Autonomy

From 1950s, in order to achieve the objective of ‘‘liberation and independence of brotherhood countries in the third world,’’ the Chinese government began to provide economic and technical aid to other developing countries. Prior to the economic reform in 1978, all construction enterprises were owned by the state and its agencies. The enterprises had little autonomy with regarding to choice of projects, which were assigned by the government and achieved through administration means (Chen, 1998). The state-owned enterprises (SOE) that comprised both the local units authorized by municipal governments and central ministry-affiliated enterprises undertook most of the construction of infrastructure projects (Low and Jiang, 2003). Staffs were assigned by government to enterprises which were responsible for meeting the lifelong social needs of them. The international concepts of employer, engineer and contractor were highly diffused; they were basically all in the same agency. Besides, the supply of materials, equipment, credit and other services were also provided by the government through a quota system (Chen, 1998). The whole industry thus could be viewed as a single large enterprise with a centralized hierarchical organization in which resources, products and services were allocated almost exclusively by administrative means (Chen, 1998).

3.1.2 Achievements

In this period, the international involvement of Chinese construction firms was mainly for financial aid projects in some developing countries with funds provided by the Chinese government (see Table 3.1.1).

Table 3.1.1 Chinese Government's Economic and Technical Aid Pre-1979

Period	Projects Undertaken			Projects Completed		
	Number	Investment over 10 million RMB	Investment over 100 million RMB	Number	Investment over 10 million RMB	Investment over 100 million RMB
1954-1963	234	32	1	101	6	0
1964-1970	555	70	10	313	31	3
1970-1978	509	101	8	470	59	7
Total	1298	203	19	884	96	10

Note: Source: EOMC 1989

These projects were agreed upon by the two governments and administered by the corresponding government authorities instead of independent enterprises. In November 1978, Chinese first international construction enterprise—China Construction Engineering Corporation (formerly the China State Construction Engineering Corporation) was established.

3.1.3 Problems

While China made impressive progress under this system, it still lagged behind developed countries as well as many developing countries in construction technology and management (Chen, 1998). Essentially, in this period these financial aid projects did not technically constitute part of the international construction market for the following reasons: (1) these were not motivated by the market place or profit-driven for the firms; (2) all project costs and other expenditure were funded by the Chinese government; and (3) firms participated in the projects were not involved in any decision-making activities. However, during this period, the Chinese construction enterprises involved in these projects gained basic information about the

international market and helped to train many personnel who played an important role when China opened its door to the world (Low and Jiang, 2003).

3.2 The Second Period from 1979 to 2001

3.2.1 Autonomy

On August 13, 1979, Chinese State Council introduced an Act which allows Chinese specialized companies to invest in other countries (Low and Jiang, 2003). At the central government level, the government started to introduce regulations to set the basic ground rules. During this period, the Ministry of Foreign Economic Relations and Trade (MOFERT) was responsible for overseas contracting business, giving approval for the enterprises to work overseas and taking general administration roles for the Chinese construction enterprises abroad (Chen, 1998).

At the enterprise level, the companies were gradually given the flexibility to operate as ‘‘commercial entities.’’ The Chinese construction industry started to reform in the early 1980s following Chinese open-door policies. Subsequently, several SOE were separated from governmental agencies, but they continued to work primarily for overseas financial aid projects until the mid-1980s. Soon after, SOEs at the central government level (under the direct administration of the corresponding Ministries) were able to obtain licenses to bid for projects in the international market. These particular licenses for construction enterprises working abroad were issued by the MOFERT, mainly to SOEs. The operations of these enterprises from then on were independent of financial aid from the Chinese government. They participated in international bidding, tendered for commercial projects and negotiated with their foreign counterparts. Their motivation soon turned to profit-driven. During this period, some of the largest SOE were established such as: China Road and Bridge Corporation, China Civil

Engineering Construction Corporation, China International Water and Electric Corporation, China National Complete Plant Import and Export Corporation, etc. Their growth was phenomenal (Low and Jiang, 2003).

Since the early 1990s, some of the largest SOE had gained experience in the international market. Subsequently, provincial-level and some other regional companies were allowed to obtain licenses for contracting overseas. By 1994, several of the more established Chinese construction companies were shaped up. Thereafter, the more profitable enterprises were encouraged to be listed in the stock market following a strict evaluation exercise, which means they would no longer be protected by the government. Between 1997 and 1998, many SOEs were completely separated from their respective government organizations. Large scale SOEs were supervised by the newly established Office of Large Scale State-Owned Enterprises under the State Council (Low and Jiang, 2003).

The management mechanism commonly adopted by Chinese companies in overseas projects includes both the intercontracting and subcontracting arrangements. Intercontracting means that the project, upon the contract being signed between the contractor and client, will be transferred to the local branch office with a percentage of overhead charges. The local branch office may contract the project wholly or partially to a project team who is from the same enterprise. Alternatively, the head office may directly contract the project to a project team with a percentage of overhead charges. Subcontracting, on the other hand, is to contract the project to other companies at a percentage of overhead charges. These companies may be Chinese, local, or from other countries. In both cases, the head office will maintain overall control of the project performance and provide the necessary assistance to the project team such as the working capital, major equipment allocation, etc (Low and Jiang, 2003).

Most of the overseas management structures of Chinese construction enterprises fall into the following categories: local agent, representative office or liaison office, subsidiaries, joint-venture company, and branch company. Some Chinese construction firms may set up a local branch office or joint venture company to pursue interests in countries where benefits are imposed. For example, in some countries, the local or joint venture companies may enjoy a 7% discount off the bidding price. Hence, this may motivate a foreign firm to set up a joint venture with a local firm. In addition, the foreign direct (FD) investments to other countries by Chinese construction firms are not very significant. It is only in a few countries where they have operated for many years with intention for a longer stay, they may establish a subsidiary or solely owned company. For example, as one of its overseas business strategies, China State Construction Engineering Corporation usually develops and operates its overseas businesses on a project basis through its 19 representative offices throughout the world. Because of the existing business foundation and the estimated future opportunities in Singapore and the Southeast Asian market, the Singapore branch company is established as an active subsidiary of China State Construction Engineering Corporation (Low and Jiang, 2003).

For the involvement of specialized fields in the construction industry, most Chinese construction firms focused on general building projects in overseas market. A few firms, with their specialized background in China, executed other specialized projects. For example, apart from general building projects, China Civil Engineering Construction Corporation (formerly under the administration of the Ministry of Railway, China) had engaged in transportation projects; China International Water and Electric Corporation (formerly under the administration of the Ministry of Water Resources, China) was adept in power and water supply projects; China Petroleum Engineering Construction Corporation (formerly under the administration of the

Ministry of Petroleum, China) was involved in industry/petroleum projects. A few Chinese construction firms were developing their specialty in a more diversified manner. For example, projects undertaken by China State Construction Engineering Corporation in 2000 covered seven specialized fields; China Harbor Engineering Co. Group was involved in five fields; China Metallurgical Construction Corporation was in seven specialized fields; and Shanghai SPECO was in six fields (Low and Jiang, 2003).

3.2.2 Achievements

Since implementation of the open-door policies in 1978, the Chinese construction industry has rapidly grown to become the third major sector of the economy, following agriculture and manufacturing (Chan and Chan, 2002). While the construction industry played one of the most important pillars in Chinese domestic economy, many Chinese enterprises had also been involved in the international construction market. About 219,900 construction workers were sent abroad by 1994. At the end of 2001, the cumulative dollar amount of overseas contracts since 1976 was reported to be $127.87 billion, of which the 2001 figure alone was $16.45 billion (Department of Foreign Economic Cooperation 2002). Most of these overseas contracts were for civil engineering works in the developing countries (Low and Jiang, 2003). This also helped the development of the construction industry at home as well (Chen, 1998). Furthermore, these construction projects contributed to the economic development in the host countries through the completion of highways, dams, hydroelectric power stations, thermo power stations, transmission lines, and buildings.

During this period, Chinese foreign contracted services include the following industries: residential, petrochemical, transportation, manufacturing, water supply and drainage, water conservancy and electric power, etc, which almost covered all the fields in international

construction market. Meanwhile the large construction companies were more concentrated in special areas. Among the top 10 Chinese contractors in the global market, eight of them had more than 50% of total turnover (in this thesis turnover equals revenue) in one business sector. And even for diversified companies among the top 10, the number of their main business sectors was still no more than three. This indicated that the specialized construction companies were more competitive in the global market.

Through 20 years of development, Chinese contractors had developed their scale, and enhanced their strength. While the number of Chinese companies entering the Top 225 largest international construction companies ranking was only one in the year of 1984, this number mounted to 39 in the year of 2001, among which China Construction Engineering Corporation ranked 19th and its international project contracts amounted to 1.09 billion dollars. The total foreign turnover of 34 ranked Chinese companies amounted to 5.36 billion dollars, sharing 5% in the overall foreign turnover of the Top 225 international construction companies. The status of Chinese engineering companies in the international market was also increasing. There were 3 Chinese companies in the ranking of Top 200 largest international design companies (Chen, 1998). While engaging in international construction, equipment made in China was also exported in large volume. The total export value of equipment and material that accompanied overseas construction projects in 2000 was $875.59 million (Department of Foreign Economic Cooperation 2001).

3.2.3 Problems

During this period, Chinese construction industry was still not yet mature enough and had been criticized for poor quality, schedule delay, and cost overrun (Walker, 1991; ADB, 1998).

Meanwhile, in the global market, Chinese contractors faced internal competition, management, material and equipment problems, despite those achievements mentioned above.

The price-war among Chinese companies in some traditional markets of developing countries (such as Pakistan, Iraq, and other Middle Eastern and African countries) commenced with their expansion overseas (Low and Jiang, 2003). In line with the promotion by the Chinese government, the number of the Chinese firms entering into international markets was growing rapidly (Low et al. 2004). The Chinese firms competed in international markets not only with the foreign contractors but also among themselves. The number of bidders for a typical infrastructure project in the international market was usually more than 10 (Zhao and Shen, 2010). In Africa, very few local contractors were able to undertake large-scale projects or had competence to compete with Chinese contractors. Thus, the competition was often between the Chinese contractors themselves. As a result of the intensive competition, there was a growing 'low-bid-price war' among the Chinese firms. The impact of this 'low-bid-price war' on Chinese construction firms in the overseas market was considerable, resulting in substantial reduction in profits.

Overseas design and consultant services were first offered by Chinese construction companies in 1995. However, the amount from design and consultant services contracts was small relative to the overall contracting value. Although Chinese construction enterprises have gained great stride in the global market, their scale of overseas operations is still small relative to their European, Japanese, and North American counterparts (Low and Jiang, 2003).

Since 1990s, to be listed on the stock market appeared to be one of the most important management and financial strategies for Chinese construction enterprises. Hence, most construction enterprises were very keen on the stock market during that period, while the tough

process of reforming the SOE was still ongoing. As a strategy, construction enterprises off-loaded their unprofitable assets in favor of more favorable assets to form new share-holding companies after strict evaluation by the Committee of China Securities and Shares. By the end of 2001, however, few construction enterprises had successfully sold their shares through their share-holding companies. Many Chinese construction enterprises are still struggling through the process of reforms to become multinational enterprises in the global market (Low and Jiang, 2003).

China is an intensive user of raw materials. Construction material generally accounts for 60% of total construction costs. In this period, every year, Chinese construction industry consumed 20 to 30% of the country's total steel production, 70% of cement, 40% of timber, 70% of glass, 50% of paint and 25% of plastic products. Building materials were consuming a huge amount of raw material resources. The main problems with the building material in China were: (I) productivity of building material manufacturers was lower compared with other manufacturers; (ii) profitability of building material was low; (iii) a quota system was still being used for estimating construction costs including those of materials. Because the information in the quota system was fixed annually or semi-annually and the material prices were flexible in the market, construction cost estimates could not be accurate (Chen, 1998).

Construction equipment was considered generally to be a weak link in the construction industry in China. Most enterprises owned their equipment. Leasing or rental facilities were rare. In general, the available equipment was old and outdated; much of which was not fully utilized and at times placed a heavy burden on the enterprises. Although about 30% of construction equipment was currently deemed old and out-of-date, it was still used because the enterprises lack of money to buy new equipment. In addition, the allowed depreciation periods for

construction equipment usually were too long, and the used equipment prices were determined by a quota system (Chen, 1998).

3.3 The Third Period from 2002 to 2008

3.3.1 New Situation after Entry to WTO

After China was formally admitted to the WTO on December 11, 2001, one of its commitments was to open the construction market (Xu et al., 2005). The underlying principle of the WTO is to encourage global trade liberalization with the core criteria of market access and national treatment. This is in accordance with the relevant clauses of the General Agreement on Trade in Services (GATS), which is the first multilateral, legally binding set of rules related to the international service trade. GATS defines the service trade as consisting of four parts: cross border, consumption abroad, commercial presence in the consuming country, and presence of natural persons. Construction is one of the major international services trade components, and it falls within the category of trade liberalization.

In this period, more than 1,600 Chinese companies had the required qualifications to carry out international engineering and construction contracts, but the dominant ones are large state-owned enterprises such as China State Construction Engineering Corp (CSCEC). The total contracting value of the 47 Chinese construction companies that ranked within the ENR "Global 225" in 2003 contributed 60 percent of the total international contracting value of all Chinese companies, and the top ten contractors accounted for almost 40 percent of total international contracting value (Reina and Tulacz, 2004).

For the types of work, international projects were mainly concentrated in building construction, communication and transportation, petrochemical industry, and power industry.

Their respective percentage shares of the contracting value in 2003 were 28.7, 24.7, 20.6, and 6.9 percent. In addition, manufacturing industry accounted for another 8.6 percent, and the remaining 10.5 percent was contributed by projects in sewage disposal, electronic communications industry, and water supply and among others (Li et al., 2001).

Furthermore, along with the growth in demand for energy in China, Chinese petroleum and natural gas companies were bidding for projects with large contracting values in the petroleum chemical industry. These companies were making progress in developing their overseas services. Three countries, Sudan, Kazakstan, and Venezuela, were emerging as important markets for these companies. Similarly, in heavy and mining industries, Chinese companies were venturing overseas to bid for projects. In 2004, Baoshan Steel Corporation signed an agreement with a Brazilian corporation, which is the world's biggest iron ore producer, to conduct a feasibility study for a $50 million integrated iron and steel complex. A similar contract was signed in Angola with the contracting value of $200 million (Li et al., 2001).

In the competitive market, it is indispensable for Chinese contractors to utilize modern managerial skill to improve their management. Much depends on the competence of professional personnel in a diverse field of expertise in management, finance, insurance, law, foreign languages, and familiarity with international practices. One of the basic needs is the ability to constantly upgrade their knowledge through training and exposure to new ideas (Liu and Li, 2004).

Besides, Chinese construction companies paid more attention to the contract mode of build-operate-transfer (BOT). BOT is widely used in more than 100 countries and is becoming increasingly popular especially in Eastern European. It involves international co-operation and requires knowledge and experience in engineering, technology, law, finance and a host of related

fields. It is characterized by substantial capital investments ranging from several hundred million to billions of dollars, and an extended period of operation lasting from 10 to 40 years.

3.3.2 Opportunities

The accession to the WTO in 2001 offered new opportunities for Chinese construction companies to conduct businesses in those countries that were traditionally against the entry of Chinese firms. According to the WTO's regulations, WTO member countries are allowed to trade without discrimination under the principles of free trade, national treatment, and fair competition. In implementing these principles, all WTO member countries must reduce trade barriers against any other members, and both foreign enterprises from WTO member countries and local enterprises should be given equal treatment. Since then, Chinese contractors have achieved significant expansion in the market other than the traditional developing countries market. For instance, the new contracts signed by Chinese contractors in Europe in 2007 are worth US$5 billion, which increased 19.3% since 2006 (MOFCOM 2008). The WTO entry also provided Chinese contractors the legal mechanism to protect their benefits. Any disputes or unfair treatments could be settled by applying WTO principles. Accordingly, Chinese contractors' confidence was increased in developing new international markets (Zhao et al., 2009).

With the benefits of entry to the WTO, some Chinese companies won contracts in Europe and America, where Chinese contractors used to occupy relatively small market shares (Cheng and Zhang, 2010). For example, the American subsidiary of CSCEC won a bid to build a high school and the technical centre worth $21.9 million in September 2002. In 2003, it was awarded contracts to build a subways station in New York and a hotel project in Manhattan. The China Metallurgy Group was awarded a contract by an America company in 2004 to build a factory for $402.5 million.

On the other hand, it was anticipated that after China became the member of the WTO, the cooperation between the international and the indigenous firms in construction joint venture projects would gradually increase. The industry should therefore be called for an urging need that a unique professional education system, to some extent adaptable to the “international” standards, must be developed in light of the development of construction profession in China (Chan and Chan, 2002).

3.3.3 Problems

During the negotiations between China and other WTO member countries regarding Chinese entry into the WTO, some of the countries required China to open its construction market to foreign companies, especially those from Japan, the United States, and Europe (Xu et al., 2005). The agreement was that foreign companies would be allowed to set up wholly owned enterprises in China five years after Chinese entry to the WTO (Low and Jiang, 2003). As a result, the Chinese construction companies would face increasing competition in the domestic market, as Chinese construction market was becoming rapidly internationalized.

Despite considerable progress in the international market from 2001 to 2003 and with projects in more than 180 countries, Chinese construction companies were still largely concentrated in their traditional markets of Asia and Africa (Tong, 2003). In 2003, half of their contracting value was derived from projects in Asia, almost a fifth from Africa, 8.4 percent from Europe. 4.7 percent from North America and only 1.2 percent from Latin America. In terms of countries and territories, more than four-fifths of the projects were in Pakistan, Sudan, Algeria, and Hong Kong (China Statistical Yearly Book, 2004).

In the increasingly keen competition for international projects, financing ability is one of the key factors in deciding the outcome of bids. Most international engineering and construction

companies are capable of handling project financing and project management. However, most Chinese companies still keep to traditional management style. Not all Chinese companies possess the necessary qualifications and they can only bid for projects in the domestic market. In the changing environment, these companies should rationalize their management structure by getting rid of useless assets, optimizing the use of capital, and adopting advanced management techniques (Cui, 2004). They should aim at becoming integrated multinational corporations capable of dealing design, building and management whether in domestic or foreign markets.

In addition, technological innovations play a crucial role in the development of the construction industry. In this regard, there is a considerable technological gap between companies in China and developed countries. It is imperative that Chinese companies pay full attention to technological innovations and adopt advanced technology in order to switch from the labor-intensive business model to the intelligence-intensive model based on scientific and technological progress (Cheng and Zhang, 2010). Taking information technology, the leading technology in the 21st century, as an example, a successful international engineering and construction company must exploit the ability to access and to utilize all types of information technology in the course of its operation and management as well as decision making (Cheng and Zhang, 2010).

3.4 Summary

Chapter 3 presents the results of the literature review for developing a background of the global expansion of Chinese construction companies. Findings of the literature review were summarized based on three periods: from 1950 to 1978, from 1979 to 2001, and from 2002 to 2008. The contents covered the autonomy of Chinese construction companies, along with their

achievements and problems and the new business environment after accession to the WTO. According to the literature review, there are two milestones in the expansion of the Chinese construction industry: the adoption of open-door policies in 1978 and the entry to the WTO in 2001.

Chapter 4

Data Collection

4.1 Data Collection Procedure

4.1.1 Data Sources

This thesis focuses on the global expansion of the Chinese construction companies from 1979 to 2008. Data used in this research include two parts: data on Chinese economic cooperation with foreign regions from 1979 to 2008, and data on the top Chinese contractors (Top CC) from 2002 to 2008. All data were complied into spreadsheets for statistical analysis. Data on Chinese economic cooperation with foreign regions from 1979 to 2008 were collected from the China Statistical Yearbook 1996 through 2009. The information of the Top CC from 2002 to 2008 was obtained from Engineering News Record (ENR) yearly reports of the Top 225 International Contractors (Top 225) from 2002 to 2009. Thus, the Top CC refer to those Chinese contractors on the Top 225 list. On the Top 225 list, companies are ranked according to construction revenue generated outside of each company's home country.

The statistic data on Chinese foreign economic cooperation include: number of countries with contracts signed, number of contracts, contracting value, turnover fulfilled, and turnover by regions. The scope of the statistic data covers construction projects, labor services, and design and consultation services in foreign countries. In the sampling scheme, a statistical unit was a corporate enterprise engaged in construction projects, labor services, and design and consultation services in foreign countries, and was approved by the Departments of Commerce at different levels. All the original data on foreign economic cooperation come from the Ministry of Commerce through a comprehensive reporting system (China Statistic Year Book 2009).

The original data on ENR's yearly reports of the Top 225 from 2002 to 2009, adopted in this study, include the international revenue (IR), the total revenue (TR), the international new contract (INC), the total new contract (TNC), and the number of firms. The statistic data cover ten types of industries (building, manufacturing, industrial, petroleum, water, sewer/waste, transportation, hazardous waste, power, and telecommunication) and seven regions (Middle East, Asia, Africa, Europe, U.S., Canada, and Latin America/Caribbean Islands). Besides, the original figures include prime contracts, shares of joint ventures, subcontracts, design-construct contracts and construction management at-risk contracts (a firm's risks are similar to those of a general contractor). The original figures also include the value of installed equipment if a firm has prime responsibility for specifying and procuring it within the scope of a construction contract (ENR 2008). Most companies provide the revenue and new contract figures on a calendar year basis, about 5% of them were unable to provide such breakdowns and provide fiscal year figures (Tulacz, 2010).

ENR first began to aggregate the revenue from Chinese contractors on the ENR Top 225 International Contractors list in the 1996 issue (reflecting 1995 revenue). It was at that time when the China International Contractors Association first began assisting ENR in encouraging its members to participate (Tulacz, 2010). While Chinese contractors had been on the ENR Top International Contractors list for many years, it was only in 1996 that they began to appear in great numbers.

4.1.2 Terminology

Construction Projects refer to projects undertaken by Chinese contractors (project contracting companies) through the bidding process in the international market. They include: (1) overseas construction projects financed by foreign investors; (2) overseas projects financed by the Chinese government through its foreign aid programs; (3) construction projects of Chinese diplomatic missions, trade offices and other institutions stationed abroad; (4) construction projects in China financed by foreign investment; (5) sub-contracted projects to be taken by Chinese contractors through a joint venture project with foreign contractor(s); and (6) housing development projects. The business income from international construction projects is the work volume of construction projects completed during the reference period, expressed in monetary terms, including completed work on projects signed in previous years (China Statistic Year Book 2009).

Labor Services refer to the activities of providing technology and labor services to employers or contractors in the forms of receiving salaries and wages. Labor services provided by contractual joint ventures of Chinese corporations are also included in the statistics of service co-operation with foreign countries. The business income of labor service cooperation is the income in the form of wages and salaries, overtime pay, bonuses and other remuneration received from the employers during the reference period (China Statistic Year Book 2009).

Design Consultation refer to projects with income for technical services provided to overseas clients. It includes geographic and topographic mapping, geological resource prospecting and survey, planning of construction areas, provision of design documents, blueprints, materials on the production process and techniques, as well as engineering, technical and economic consultation, feasibility study, and research and evaluation of projects. Items also

included under this category are the above-mentioned services of foreign-financed projects in China that are paid in foreign currencies (China Statistic Year Book 2009).

Building in ENR yearly reports refers to commercial buildings, offices, stores, educational facilities, government buildings, hospitals, medical facilities, hotels, apartments, housing, and etc. Manufacturing refers to auto assembly, electronic assembly, textile plants, and etc. Power refers to thermal and hydroelectric power plants, waste-to-energy plants, transmission lines, substations, cogeneration plants, and etc. Water supply refers to dams, reservoirs, transmission pipelines, distribution mains, irrigation canals, desalination and drinking water treatment plants, pumping stations, and etc. Sewerage/solid waste refers to sanitary and storm sewers, treatment plants, pumping plants, incinerators, industrial waste facilities, and etc. Industrial refers to pulp and paper mills, steel mills, nonferrous metal refineries, pharmaceutical plants, chemical plants, food and other processing plants, and etc. Petroleum refers to refineries, petrochemical plants, offshore facilities, pipelines, and etc. Transportation refers to airports, bridges, roads, canals, locks, dredging, marine facilities, piers, railroads, tunnels, and etc. Hazards waste refers to chemical and nuclear waste treatment, asbestos and leads abatement, and etc. Telecommunication refers to transmission lines & cabling, towers & antennae, Web hotels, and etc.

The revenue in ENR's yearly report of Top 225 is simply the gross revenue, including pass-through and revenue subsequently paid to subcontractors, derived from construction contracting during the relevant year (Tulacz, 2010). In many countries, such as China, it is called "turnover." As for new contracts, that is simply a sales figure. It includes the contractual value of all new contracts awarded during the year in question, even if no work was performed to execute the contract in the measured year. Here is an example. A company that wins a 100 million USD

contract in 2009 to build a road can claim all 100 million USD in the "new contract," but only the actual portion of that contract that was actually spent during 2009 for work performed on the contract can be claimed in the revenue category.

4.1.3 Data Analysis Method

Some data for this research, such as the average IR per Top CC and the Top CC's IR in Middle East, will be processed and projected using a time series plot. A time series plot is a graphical representation of the data trend, which can be used to analyze prediction. This analysis is also called regression analysis. Through regression analysis, the trend, in the plot, can be extended beyond the existing data in order to predict the future value. In addition, all data analysis in this thesis will not take currency inflation into account.

R squared value (ranging from 0 to 1), also known as coefficient of determination, is an index measuring the fitting degree of the prediction. Its value can indicate the fitting degree between the estimated value from the plot and the corresponding existing data. The higher the fitting degree is, the higher the reliability of the prediction is. As a result, when the R squared value of the prediction equals or approaches 1, the reliability of the prediction is the highest; if it is close to 0, the prediction will be less reliable.

In statistics, R squared value is calculated as follows (Johnson, 2005):

$$R^2 = SS_{reg} / SS_{total}, \; SS_{total} = SS_{reg} - SS_{resid} \quad (1)$$

$$R^2 = 1 - SS_{resid} / SS_{total} \quad (2)$$

where: SS is the sum of squares.

A data set has values y_i, each of which has an associated modeled value $\hat{y}_i$. Here, the values y_i are called the observed values and the modeled values $\hat{y}_i$ are sometimes called the predicted values.

$SS_{total} = \sum(y_i - \overline{y})^2$, the total sum of squares. (3)

$SS_{reg} = \sum(\hat{y}_i - \overline{y})^2$, the regression sum of squares. (4)

$SS_{resid} = \sum(y_i - \hat{y}_i)^2$, the sum of squares of residuals. (5)

In the above $\overline{y}$ is the mean of the observed data:

$$\overline{y} = \frac{1}{n}\sum_i^n y_i \quad (6)$$

During the data analysis, the type of prediction functions will be chosen depending on the R squared value. For example, if choosing linear type, the R squared value is 0.9141, while choosing cubic polynomial function, the R squared value is 1, then compared with the linear type of regression analysis, the cubic polynomial function fits the existing data better.

4.2 Collected Datasets

4.2.1 Chinese Foreign Economic Cooperation

Data on Chinese foreign economic cooperation with foreign regions from 1979 to 2008 include the number of countries or territories with contract signed, the number of contracts by types (total, construction projects, labor services, and design consultation) and the corresponding percentages, the turnovers fulfilled by types and the corresponding percentages, average turnovers per contract by types, and the turnovers by regions (total, Asia, Africa, Europe, Latin America, North America, Oceanic & Pacific Islands, others and Inner Country) and the corresponding percentages. Besides, the necessary growth rates of the corresponding data were calculated through the data analysis. Because the data were obtained from multiple sources, the available time period differs in some items, such as the turnovers by regions and the related data on design consultation.

4.2.2 Top Chinese Contractors

Data on the Top CC from 2002 to 2008 include: IR by Top 225 and the corresponding percentages, TR by Top 225, INC by Top 225 and the corresponding percentages, TNC, IR by types (building, manufacturing, industrial, petroleum, water, sewer/waste, transportation, hazardous waste, power, telecommunication and other) and the corresponding percentages, IR by regions (Canada, U.S., Latin America, Caribbean Islands, Europe, Middle East, Asia/Australia, North Africa, South/Central Africa, and unallocated/other) and the corresponding percentages, the number of firms by regions, the number of Top CC, IR by Top CC and the corresponding percentages, average revenue per firm, and Top CC's IR by regions and the corresponding percentages. Besides, the necessary growth rates of the corresponding data were calculated through the data analysis. Some regions may not add up to 100% due to omission of "other" miscellaneous market categories and rounding.

Chapter 5

Data Analysis on the Global Expansion of Chinese Construction Companies

In this chapter, data analysis is divided into two periods based on the two milestones: the adoption of open-door policies in 1978 and the entry to the WTO in 2001. Due to the shortage of comprehensive and continuous data from 1950 to 1978, the first period mentioned in literature review is not covered in the data analysis. In fact, prior to 1970s, the international involvement of Chinese construction firms is mainly for financial aid projects in some developing countries with funds provided by the Chinese government. As mentioned above, these projects did not technically constitute part of the international construction market. Thus, only two periods (from 1979 to 2001 and from 2002 to 2008) were chosen for data analysis. In addition, all data analysis in this thesis did not take currency inflation into account.

5.1 Expansion from 1979 to 2001

5.1.1 Market Size

5.1.1.1 Number of Countries and Contracts

Table 5.1.1 presents the number of countries or territories where Chinese construction companies had business and the number of signed contracts from 1976 to 2001. Those contracts included three areas: construction projects, labor services and design consultation. Their respective percentages in overall contracts are also presented in the table. The data collected on the design consultation only covers from 1995 to 2001 due to data availability.

Table 5.1.1 Number of Countries and Contracts from 1979 to 2001

Year	Number of Countries or Territories with Contracts Signed	Number of Contracts by Types						
		Construction Projects		Labor Services		Design Consultation		Total Contracts (Unit)
		Unit	Percent	Unit	Percent	Unit	Percent	
1976-1979	11	33	76.7%	10	23.3%	NA	NA	43
1980	16	138	80.2%	34	19.8%	NA	NA	172
1981	36	250	68.9%	113	31.1%	NA	NA	363
1982	38	195	62.1%	119	37.9%	NA	NA	314
1983	40	280	60.9%	180	39.1%	NA	NA	460
1984	52	344	46.5%	396	53.5%	NA	NA	740
1985	71	465	50.4%	458	49.6%	NA	NA	923
1986	83	486	51.5%	458	48.5%	NA	NA	944
1987	95	616	42.5%	833	57.5%	NA	NA	1,449
1988	103	642	30.2%	1,484	69.8%	NA	NA	2,126
1989	124	776	25.0%	2,324	75.0%	NA	NA	3,100
1990	122	920	17.8%	4,255	82.2%	NA	NA	5,175
1991	147	1,171	13.9%	7,267	86.1%	NA	NA	8,438
1992	159	1,164	12.4%	8,241	87.6%	NA	NA	9,405
1993	158	1,393	12.0%	10,212	88.0%	NA	NA	11,605
1994	171	1,702	9.7%	15,789	90.3%	NA	NA	17,491
1995	178	1,558	8.1%	17,397	90.0%	366	1.9%	19,321
1996	178	1,634	6.6%	22,723	91.3%	534	2.1%	24,891
1997	181	2,085	7.3%	25,743	90.5%	614	2.2%	28,442
1998	188	2,322	8.9%	23,191	89.4%	442	1.7%	25,955
1999	187	2,527	12.0%	18,173	86.0%	426	2.0%	21,126
2000	181	2,597	11.0%	20,474	86.9%	494	2.1%	23,565
2001	NA	5,836	14.8%	33,358	84.7%	206	0.5%	39,400

Note: Adapted from the China Statistical Yearbook 2009

As presented in Table 5.1.1, Chinese construction companies carried out international projects in only 11 countries or territories during 1976 to 1979. After the open-door policies, this number grew gradually at an average of 8 countries per year, up to the highest amount of 188 by the year of 1998. Afterwards, this amount went down slightly to 181, but still covered almost all 193 widely recognized sovereign states. There was an increase of about 900 times more than the original number of 43 contracts during 1976 to 1979. It decreased after 1998, in which year the

number of countries or territories reached its maximum. The total number of contracts jumped up to 39,400 in the year of 2001.

As for the construction projects, Figure 5.1.1 shows that its number increased steadily and slightly from 1976 to 2000 but with a sharp rise in 2001; while its percentage in overall contracts, including construction projects, labor services and design consultation, declined in most years. This decline was due to the number of other contracts increasing much more than that of construction projects, which will be illustrated next.

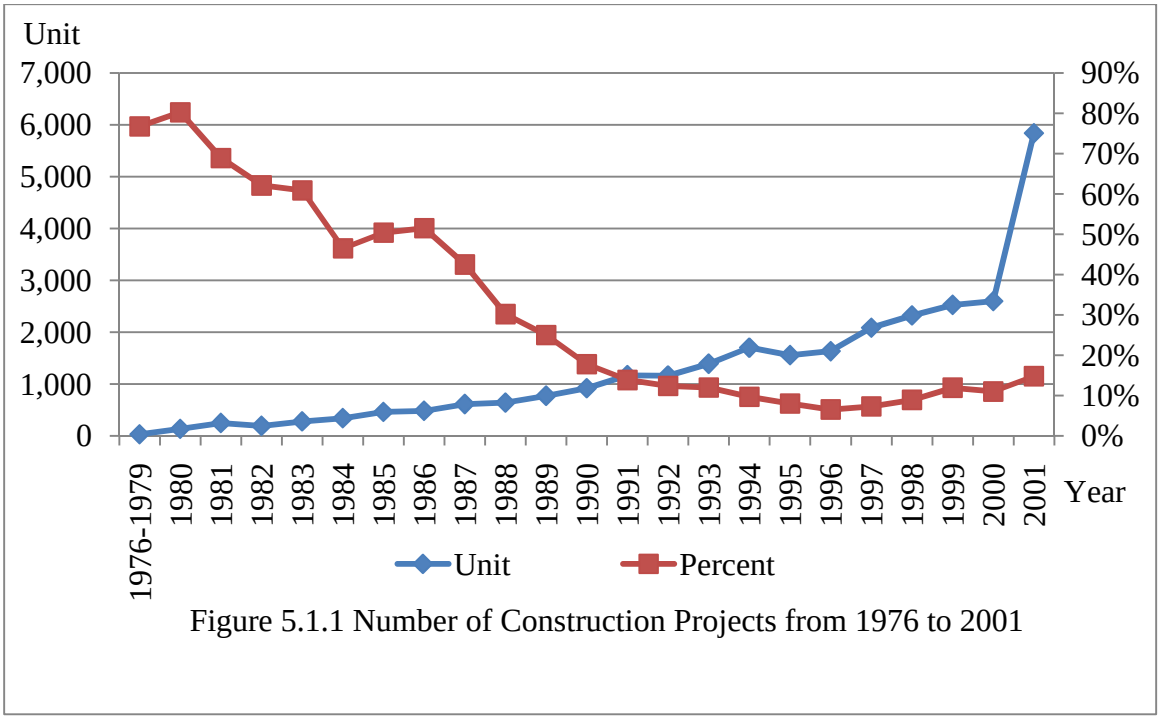

Figure 5.1.1 Number of Construction Projects from 1976 to 2001

Note: Left scale shows unit; Right scale shows percentage.

The main driving force for the increase of the total number of contracts was labor services. Its number contributed 80% to 90% in overall contracts from 1990 to 2001. Figure 5.1.2 shows that the number of labor services was rising constantly until the year of 1998, which was same as that of overall contracts. In the year of 2001, it jumped to 33,358.

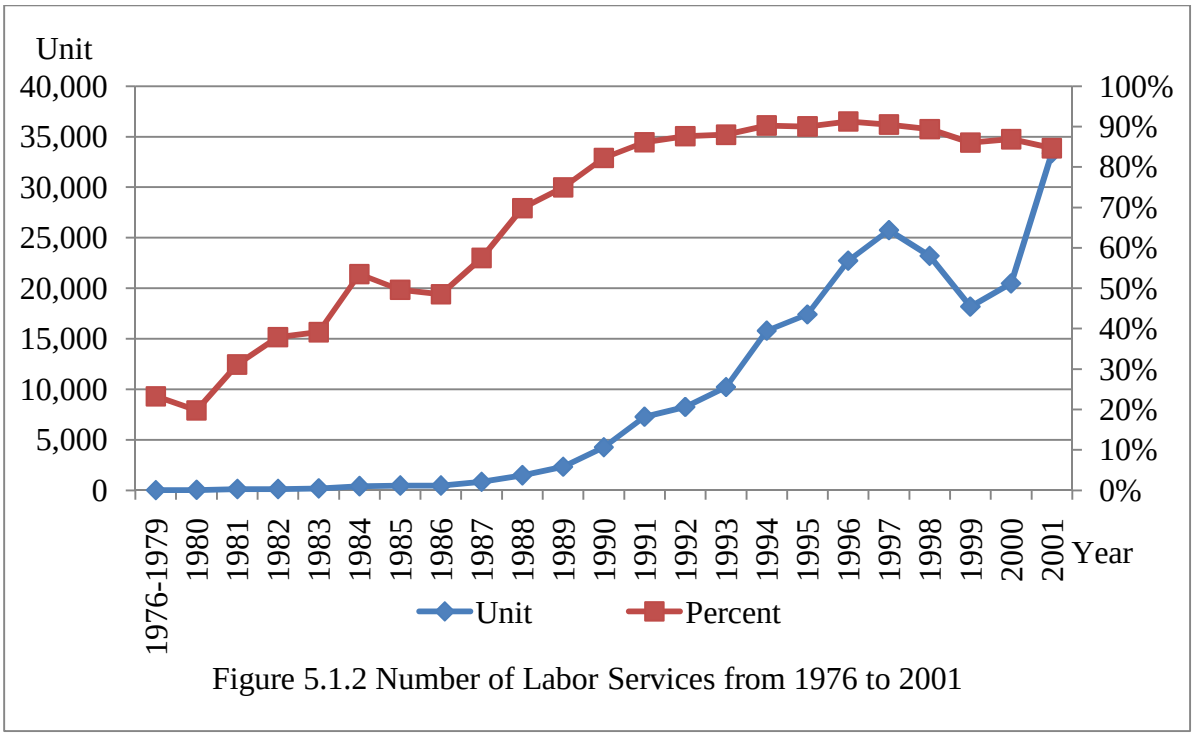

Figure 5.1.2 Number of Labor Services from 1976 to 2001

Note: Left scale shows unit; Right scale shows percentage.

In comparison with labor services and construction projects, the number and percentage of design consultation was relatively small. Six hundred fourteen was the maximum number during 1996 to 2001, which only accounted for 2.0% of overall contracts as shown in Figure 5.1.3.

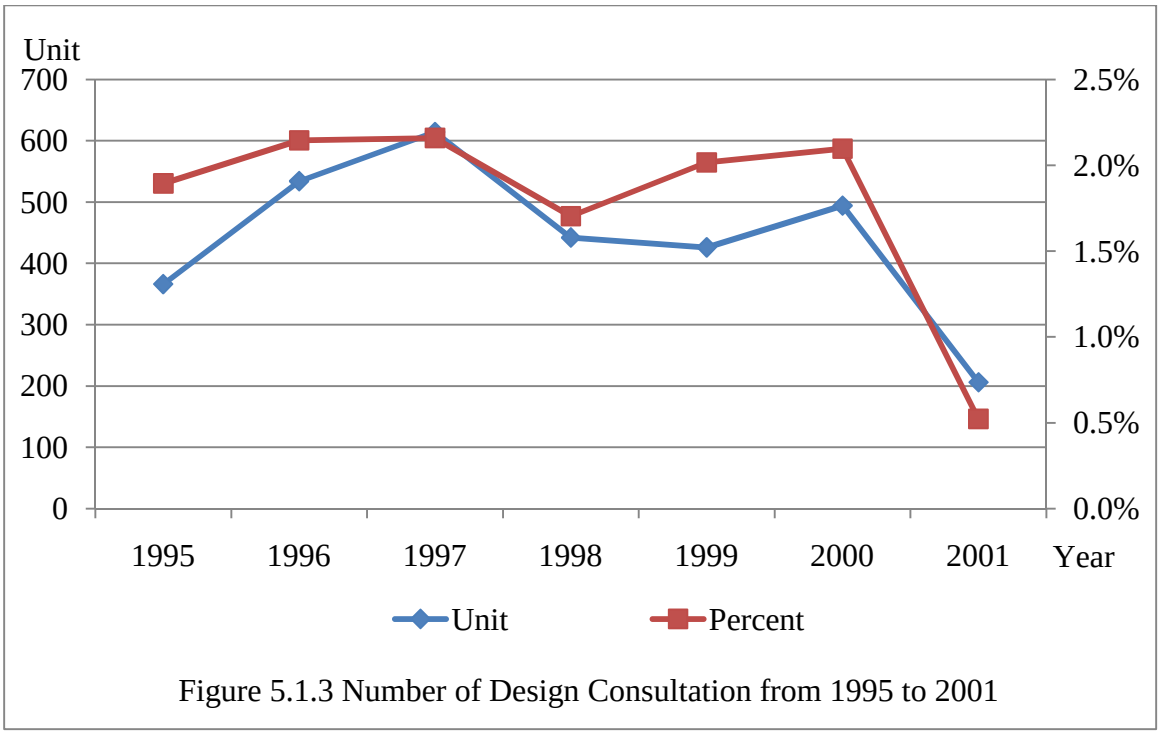

Figure 5.1.3 Number of Design Consultation from 1995 to 2001

Note: Left scale shows unit; Right scale shows percentage.

Figure 5.1.4 describes the percentage of change in the number of labor services and construction projects, which accounted for nearly all international contracts during 1976 to 2001 as the number of design consultation contracts was too little. At the beginning the percentage of construction projects was relatively high at about 80%, but then it dropped. Between the years of 1984 and 1987, the share of construction projects and labor services was about equal. And then, the percentage of labor services went on to rise while that of construction projects continued to decline. Since 1994, their ratio had been stabilized at about 9 to 1.

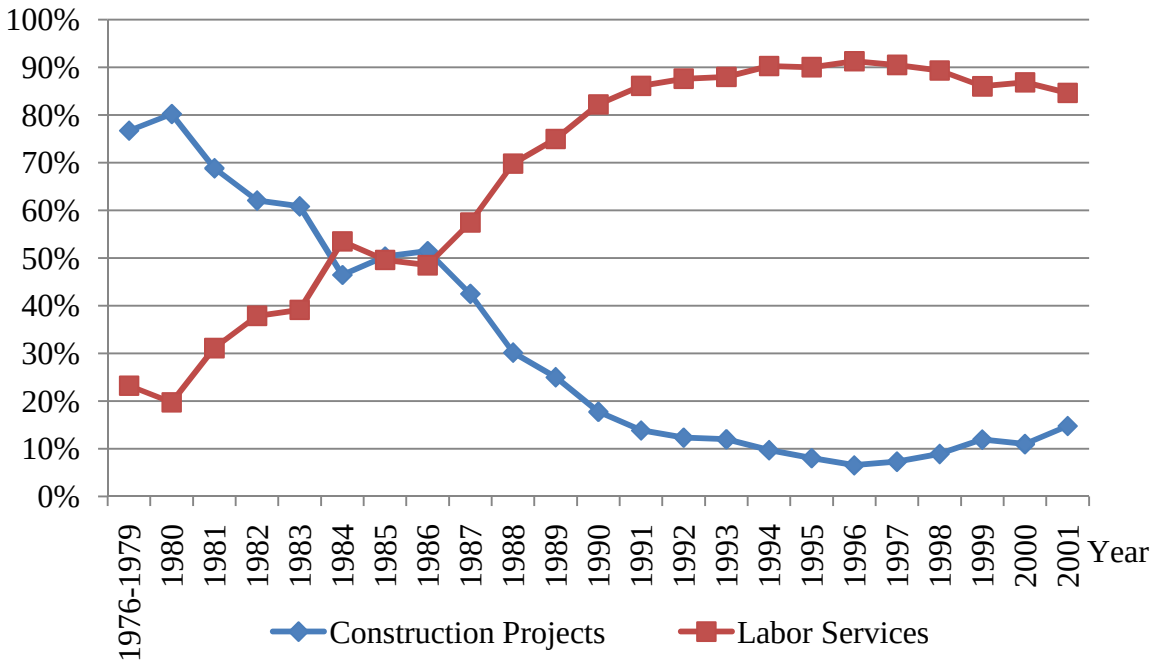

Figure 5.1.4 Comparison of Percentage between Construction Projects and Labor Services from 1976 to 2001

5.1.1.2 Contracting Value

Table 5.1.2 shows a picture of contracting value including construction projects, labor services, design consultation, and total value from 1976 to 2001.

Table 5.1.2 Contracting Value from 1979 to 2001

Year	Contracting Value by Types (100 million USD)						
	Construction Projects		Labor Services		Design Consultation		Total Contracting Value
	Value	Percent	Value	Percent	Value	Percent	
1976-1979	0.35	66.0%	0.18	34.0%	NA	NA	0.53
1980	1.40	75.7%	0.45	24.3%	NA	NA	1.85
1981	2.76	54.8%	2.28	45.2%	NA	NA	5.04
1982	3.46	68.2%	1.61	31.8%	NA	NA	5.07
1983	7.99	86.5%	1.25	13.5%	NA	NA	9.24
1984	15.38	88.5%	1.99	11.5%	NA	NA	17.37
1985	11.16	88.2%	1.49	11.8%	NA	NA	12.65
1986	11.89	87.5%	1.70	12.5%	NA	NA	13.59
1987	16.48	87.2%	2.41	12.8%	NA	NA	18.89
1988	18.13	83.5%	3.59	16.5%	NA	NA	21.72
1989	17.81	80.5%	4.31	19.5%	NA	NA	22.12
1990	21.25	81.6%	4.78	18.4%	NA	NA	26.04
1991	25.24	69.9%	10.85	30.1%	NA	NA	36.09
1992	52.51	79.7%	13.35	20.3%	NA	NA	65.85
1993	51.89	76.3%	16.11	23.7%	NA	NA	68.00
1994	60.28	75.5%	19.60	24.5%	NA	NA	79.88
1995	74.84	77.4%	20.07	20.8%	1.81	1.9%	96.72
1996	77.28	75.2%	22.80	22.2%	2.65	2.6%	102.73
1997	85.16	75.0%	25.50	22.5%	2.90	2.6%	113.56
1998	92.43	78.5%	23.90	20.3%	1.40	1.2%	117.73
1999	101.99	78.4%	26.32	20.2%	1.71	1.3%	130.02
2000	117.19	78.4%	29.91	20.0%	2.33	1.6%	149.43
2001	130.39	79.2%	33.28	20.2%	0.88	0.5%	164.55

Note: Adapted from the China Statistical Yearbook 2009

Since the adoption of open-door policies, the overall trend of total contracting value was upward as shown in Figure 5.1.5. It grew moderately until 1991, when the total contracting value experienced a sharp jump, followed by a much faster increase. In 2001 the total contracting value reached 16,455 million USD, which was about 310 times (without taking currency inflation into account) of the value during 1976 to 1979.

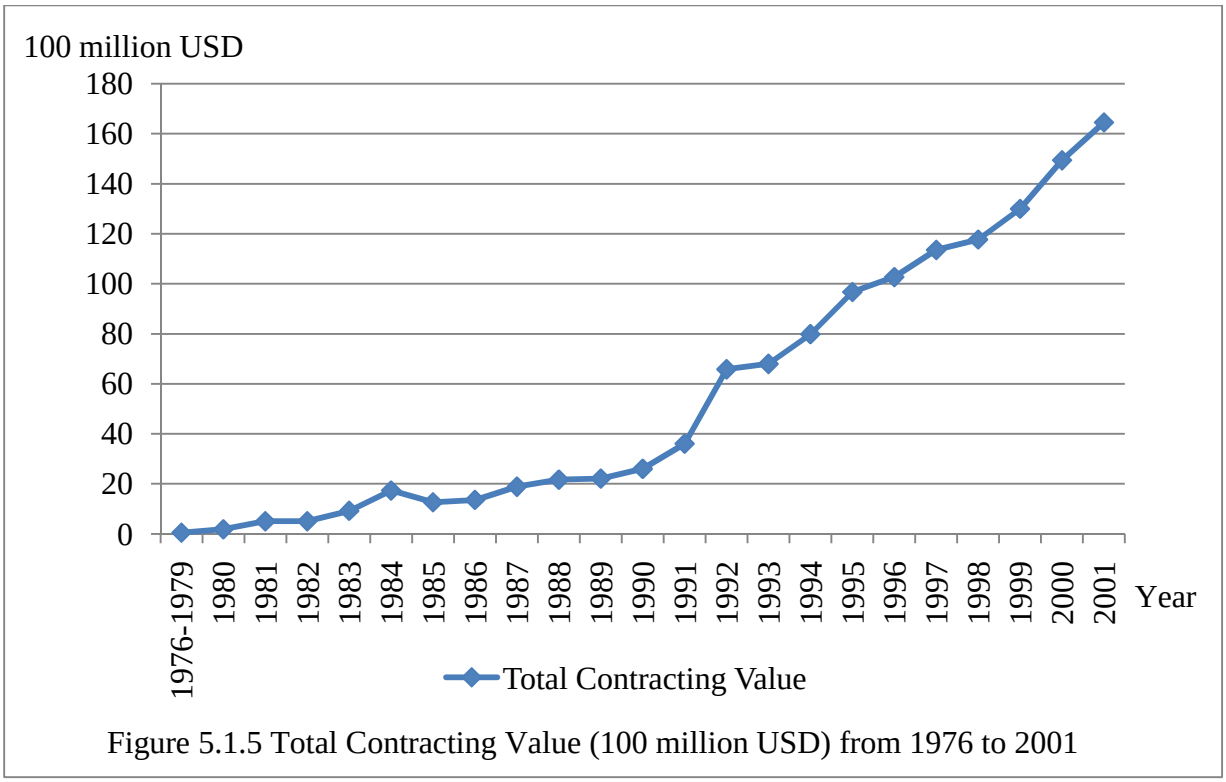

Figure 5.1.5 Total Contracting Value (100 million USD) from 1976 to 2001

The growth of the contracting value of construction projects was quite similar to that of total contracting value as shown above. It went up slowly at first and then speeded up after 1991, as illustrated in Figure 5.1.6. Its percentage in total contracting value fluctuated in a short period before 1983, and then it tended to be stable in the range between 75% and 90%, except one sharp drop occurring in 1991.

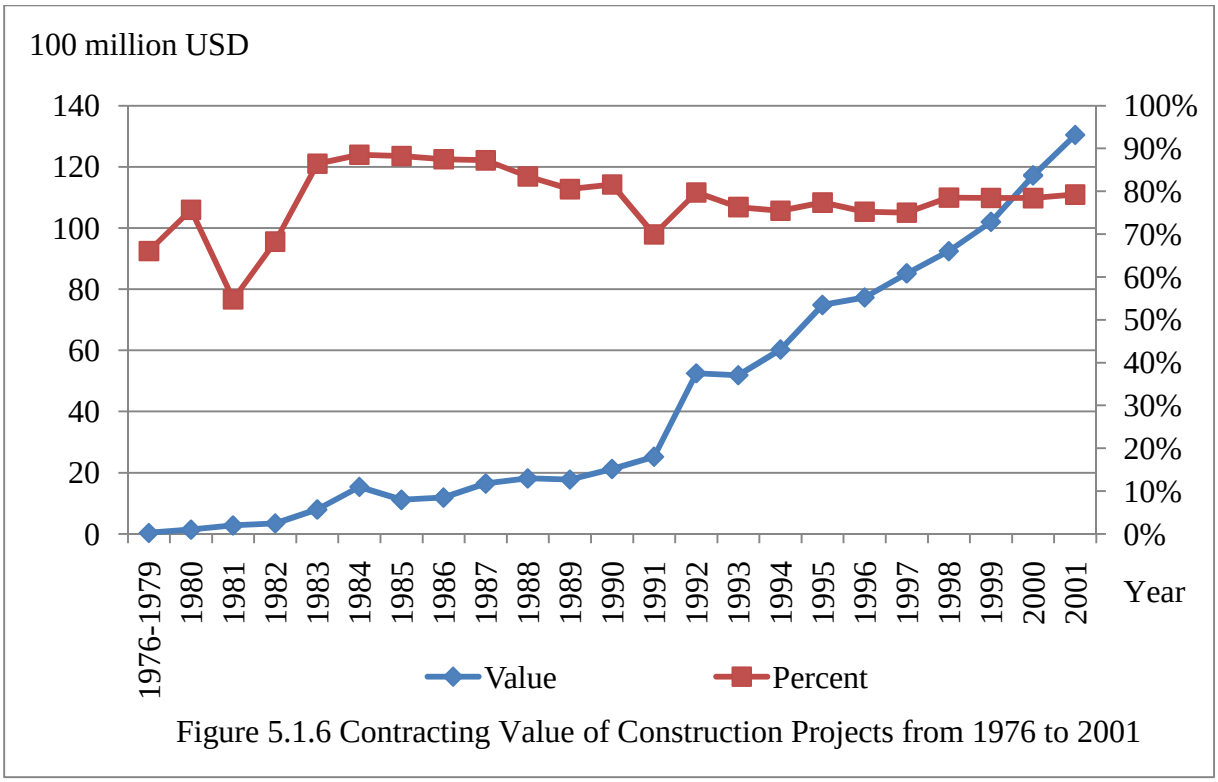

Figure 5.1.6 Contracting Value of Construction Projects from 1976 to 2001

Note: Left scale shows value; Right scale shows percentage.

As for the labor services, according to Figure 5.1.7, its contracting value had the similar upward trend as that of construction projects. Its proportion in total contracting value was in the range of 11% to 45%. After 1992 it fluctuated slightly at about 20% level.

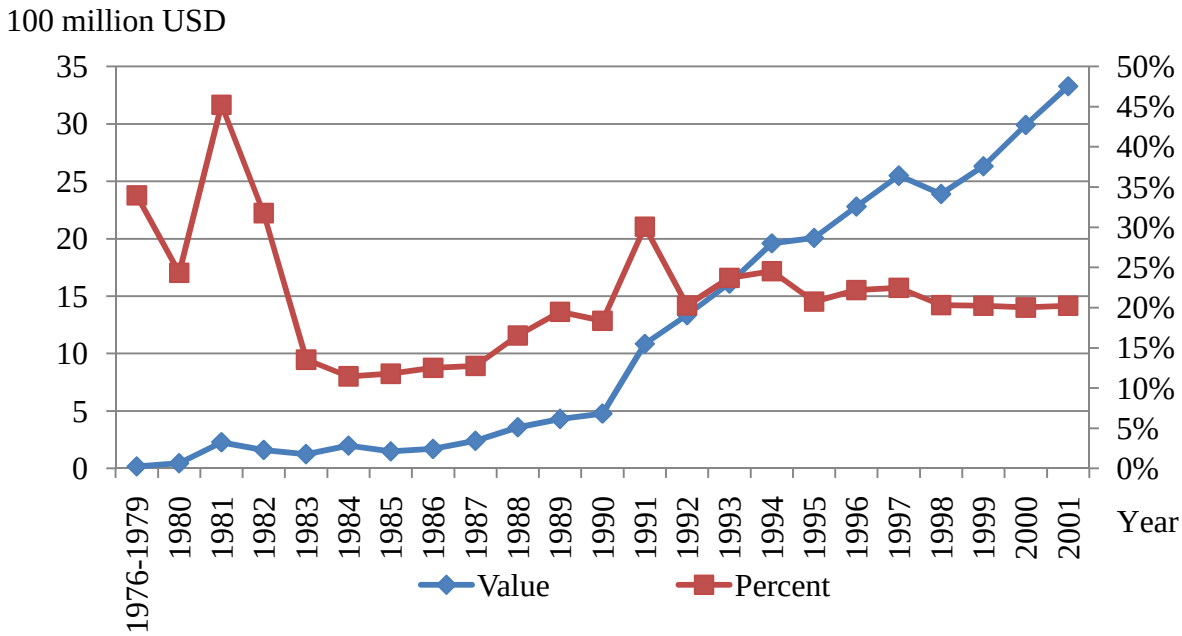

Figure 5.1.7 Contracting Value of Labor Services from 1976 to 2001

Note: Left scale shows value; Right scale shows percentage.

Both contracting value and percentage of design consultation in total contracting value were relatively insignificant from 1995 to 2001, as presented in Figure 5.1.8.

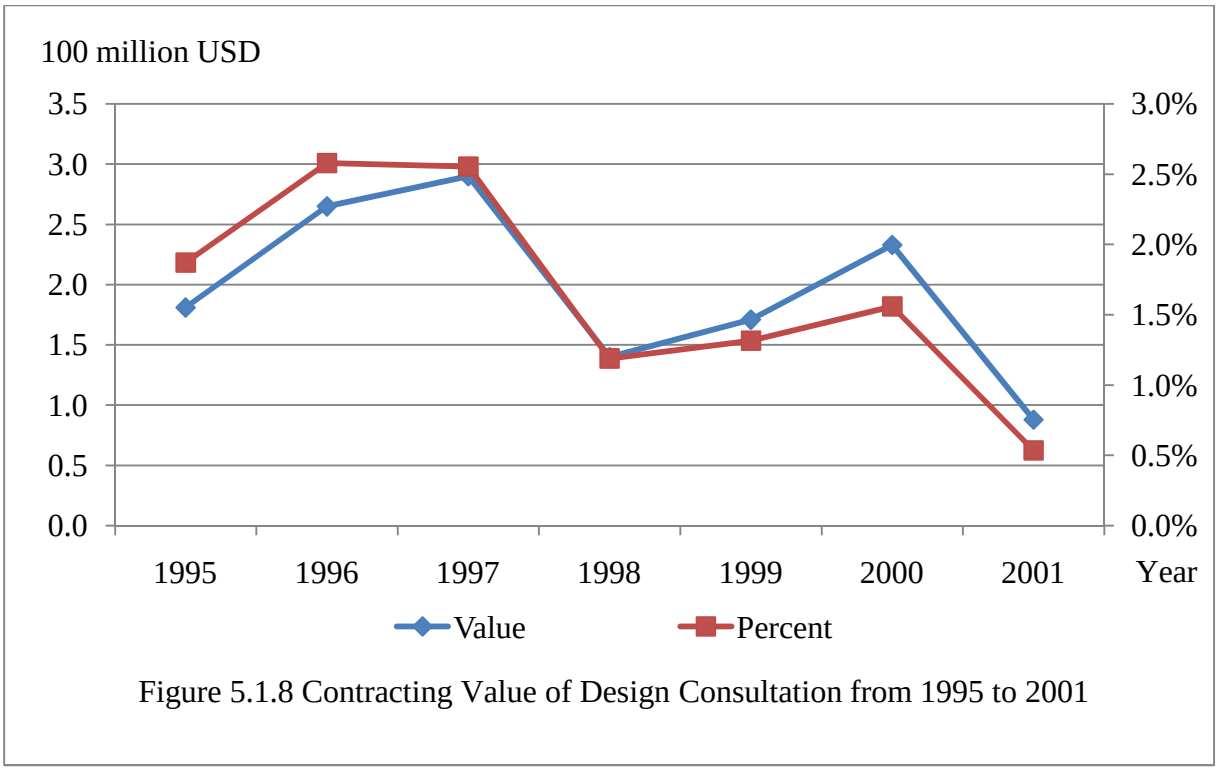

Figure 5.1.8 Contracting Value of Design Consultation from 1995 to 2001

Note: Left scale shows value; Right scale shows percentage.

Figure 5.1.9 presents the percentage of change in the contracting values between construction projects and labor services. As indicated, after 1992 the ratio of construction projects and labor services was about 4 to 1 (80% to 20%).

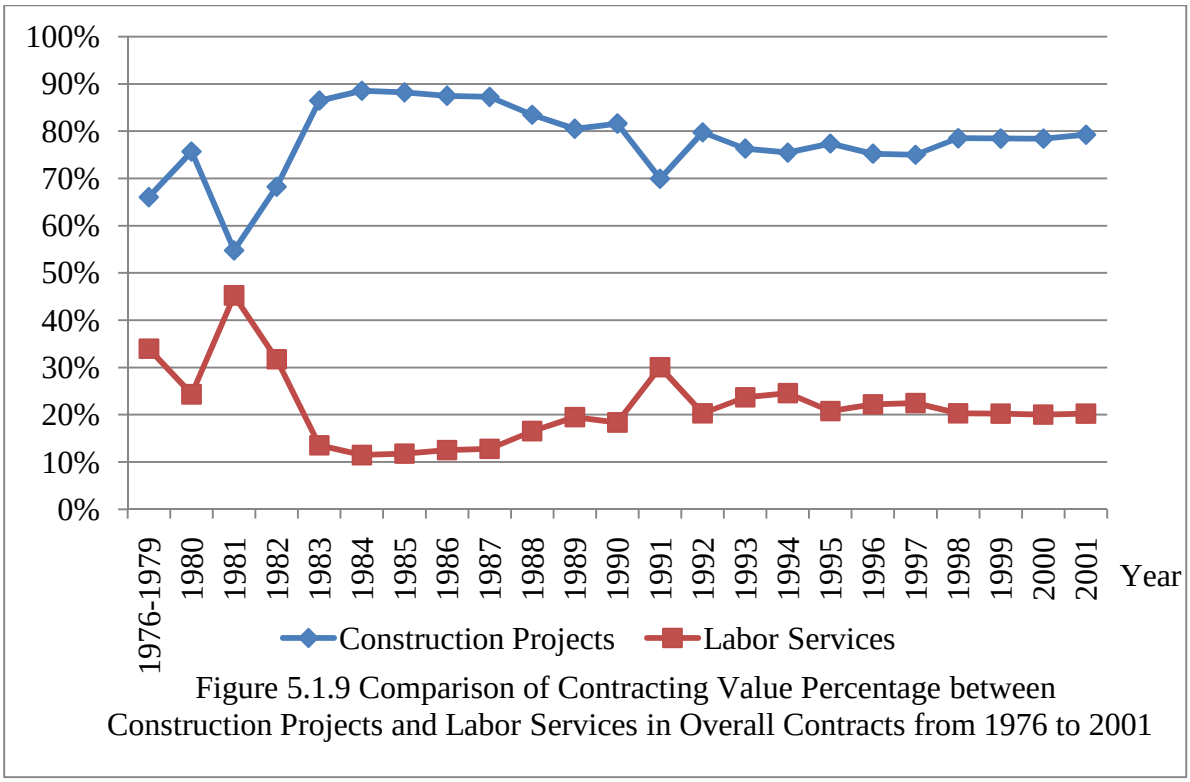

Figure 5.1.9 Comparison of Contracting Value Percentage between Construction Projects and Labor Services in Overall Contracts from 1976 to 2001

5.1.1.3 Turnover Fulfilled

Table 5.1.3 shows the turnover fulfilled by Chinese contractors from 1980 to 2001 including construction projects, labor services, design consultation, and total turnover value.

Table 5.1.3 Turnover Fulfilled from 1980 to 2001

Year	Turnover Fulfilled by Types (100 million USD)						
	Construction Projects		Labor Services		Design Consultation		Total Value
	Value	Percent	Value	Percent	Value	Percent	
1980	1.23	72.4%	0.47	27.6%	NA	NA	1.70
1981	NA	NA	NA	NA	NA	NA	NA
1982	1.89	54.3%	1.59	45.7%	NA	NA	3.48
1983	3.15	69.7%	1.37	30.3%	NA	NA	4.52
1984	4.94	79.3%	1.29	20.7%	NA	NA	6.23
1985	6.63	79.4%	1.72	20.6%	NA	NA	8.35
1986	8.19	84.2%	1.54	15.8%	NA	NA	9.73
1987	11.14	88.4%	1.46	11.6%	NA	NA	12.60
1988	12.53	87.6%	1.77	12.4%	NA	NA	14.30
1989	14.84	88.0%	2.02	12.0%	NA	NA	16.86
1990	16.44	88.1%	2.23	11.9%	NA	NA	18.67
1991	19.70	83.4%	3.93	16.6%	NA	NA	23.63
1992	24.03	78.8%	6.46	21.2%	NA	NA	30.49
1993	36.68	80.8%	8.70	19.2%	NA	NA	45.38
1994	48.83	81.7%	10.95	18.3%	NA	NA	59.78
1995	51.08	77.5%	13.47	20.4%	1.33	2.0%	65.88
1996	58.21	75.6%	17.12	22.2%	1.64	2.1%	76.96
1997	60.36	72.0%	21.65	25.8%	1.82	2.2%	83.83
1998	77.69	76.7%	22.76	22.5%	0.89	0.9%	101.34
1999	85.22	75.9%	26.23	23.3%	0.90	0.8%	112.35
2000	83.79	74.0%	28.13	24.8%	1.34	1.2%	113.25
2001	88.99	73.3%	31.77	26.2%	0.63	0.5%	121.39

Note: Adapted from the China Statistical Yearbook 2009

The total value of turnover fulfilled by Chinese contractors started from only 170 million USD in the year of 1980. This value reached 12,139 million in the year of 2001, increasing by about 70 times, as shown in Table 5.1.3. The total value of turnover never dropped during this period, though the growth rate fluctuated slightly.

Although the value of turnover fulfilled of construction projects by Chinese contractors was only 123 million USD in 1980, it accounted for 72.4% of overall international contracts

fulfilled by Chinese companies overseas. This indicated that the scale of Chinese international contracting was extremely small at 170 million USD during that time. The turnover of construction projects increased moderately at an average growth rate of about 200 million USD per year from 1982 to 1991. Followed by a quick mounting, the turnover reached 4.88 billion USD in 1994. Afterwards, it rose gradually to 8.90 billion USD that accounted for 73.3% of the total turnover value as shown in Figure 5.1.10.

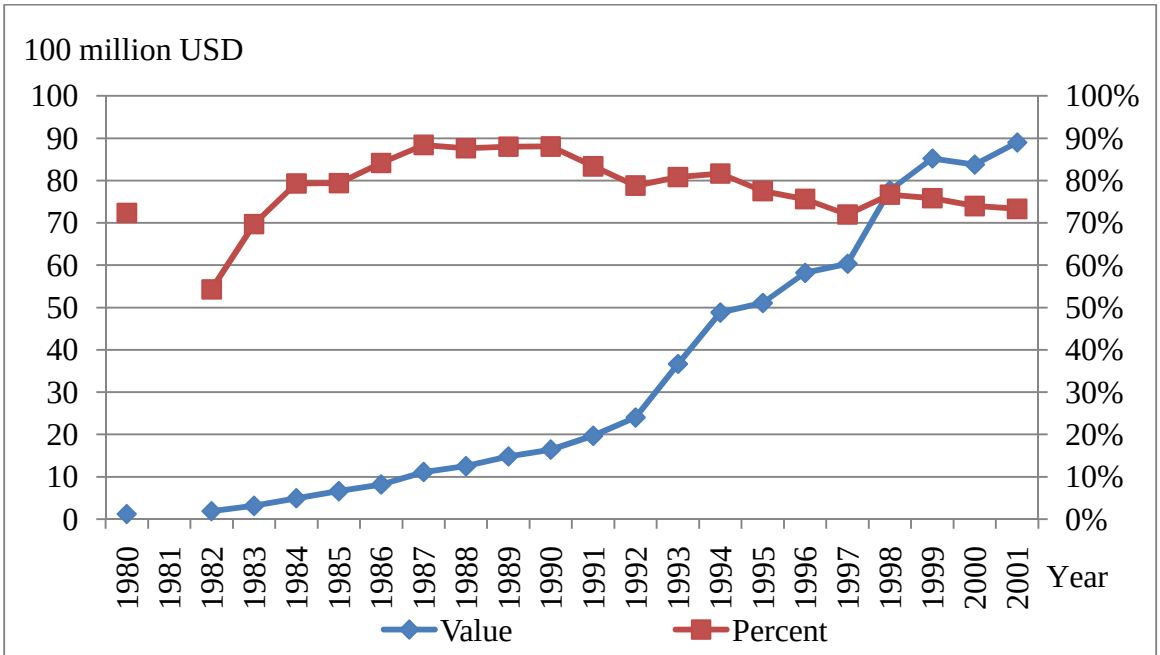

Figure 5.1.10 Turnover Fulfilled of Construction Projects from 1980 to 2001

Note: Left scale shows value; Right scale shows percentage.

The turnover value of labor services remained stable until 1990. Then it increased constantly at an average growth rate of about 278 million USD per year during the following decade. In 2001 the turnover fulfilled in labor services was 3.177 billion USD, which was increased by about 708% from 1991. Its percentage in overall international contracts was 45.7%

in 1982, followed by a sharp drop to 20.7% in 1984. Then it fluctuated in the range of 11% to 26% as shown in Figure 5.1.11.

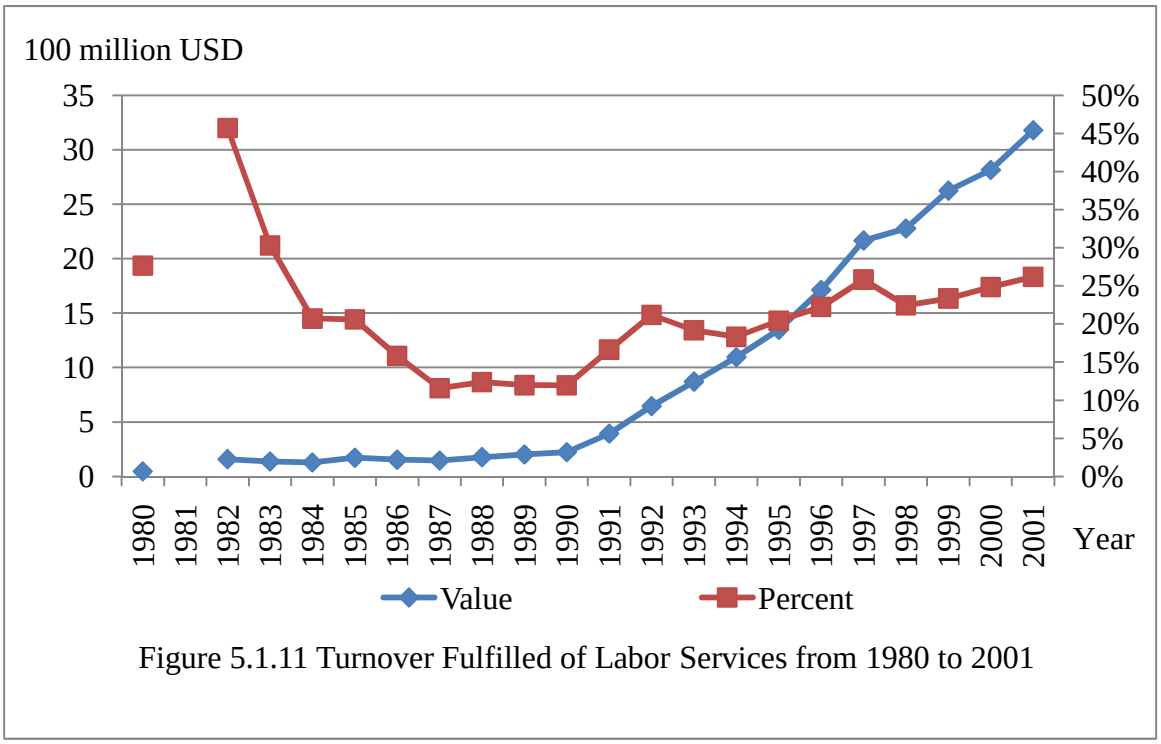

Figure 5.1.11 Turnover Fulfilled of Labor Services from 1980 to 2001

Note: Left scale shows value; Right scale shows percentage.

The turnover of design consultation accounted for less than 2.2% in the overall international contracts from 1995 to 2001 as shown in Figure 5.1.12. Compared with that of construction projects and labor services, at about 75% and 23%, respectively from 1995 to 2001, it was insignificant.

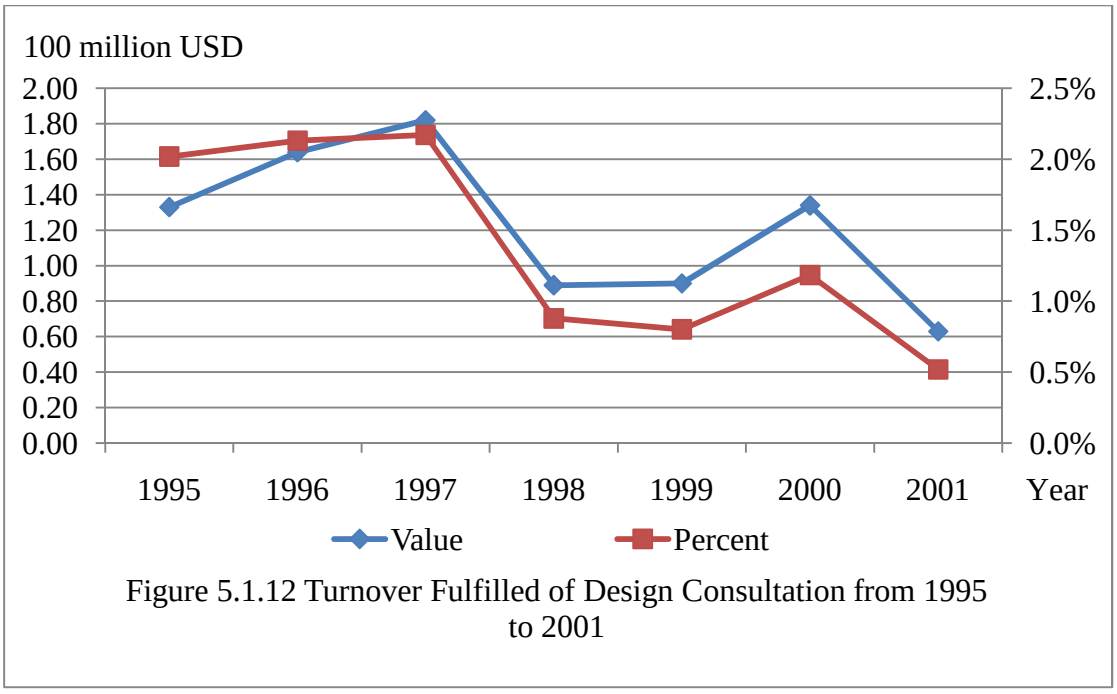

Figure 5.1.12 Turnover Fulfilled of Design Consultation from 1995 to 2001

Note: Left scale shows value; Right scale shows percentage.

The turnover fulfilled percentages of construction projects and labor services were about equal in 1982. Then the percentage of construction projects increased while the percentage of labor services decreased until they reached 90% and 10%, respectively, in 1987. Afterwards, their difference was approached to 50% in 2001 as indicated in Figure 5.1.13.

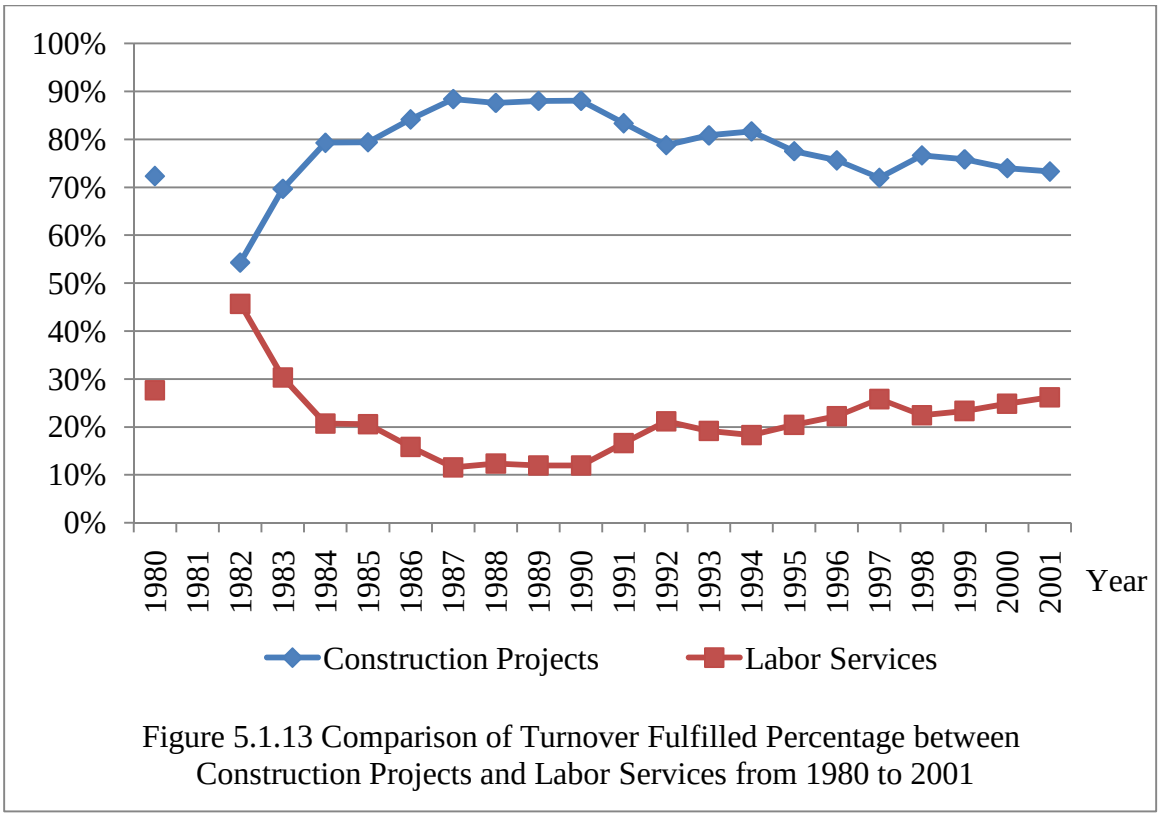

Figure 5.1.13 Comparison of Turnover Fulfilled Percentage between Construction Projects and Labor Services from 1980 to 2001

5.1.1.4 Average Turnover per Contract

Table 5.1.4 shows the average annual turnover per contract from 1980 to 2001 in the four areas including construction projects, labor services, design consultation, and overall projects. The average annual turnover per contract was calculated using the total turnover per year of four items: construction projects, labor services, design consultation, and overall international contracts shown in Table 5.1.3, divided by the total number per corresponding year of the same four items in Table 5.1.1.

Table 5.1.4 Average Turnover per Contract from 1979 to 2001

Average Turnover per Contract (10 thousand USD)				
Year	Construction Projects	Labor Services	Design Consultation	Overall
1980	89.13	138.24	NA	98.84
1981	NA	NA	NA	NA
1982	96.92	133.61	NA	110.83
1983	112.50	76.11	NA	98.26
1984	143.60	32.58	NA	84.19
1985	142.58	37.55	NA	90.47
1986	168.52	33.62	NA	103.07
1987	180.84	17.53	NA	86.96
1988	195.17	11.93	NA	67.26
1989	191.24	8.69	NA	54.39
1990	178.70	5.24	NA	36.08
1991	168.23	5.41	NA	28.00
1992	206.44	7.84	NA	32.42
1993	263.32	8.52	NA	39.10
1994	286.90	6.94	NA	34.18
1995	327.86	7.74	36.34	34.10
1996	356.24	7.53	30.71	30.92
1997	289.50	8.41	29.64	29.47
1998	334.58	9.81	20.14	39.04
1999	337.24	14.43	21.13	53.18
2000	322.64	13.74	27.13	48.06
2001	152.48	9.52	30.58	30.81

Note: Adapted from the China Statistical Yearbook 2009

The average annual turnover per contract of overall international contracts had a downward trend as illustrated in Figure 5.1.14.

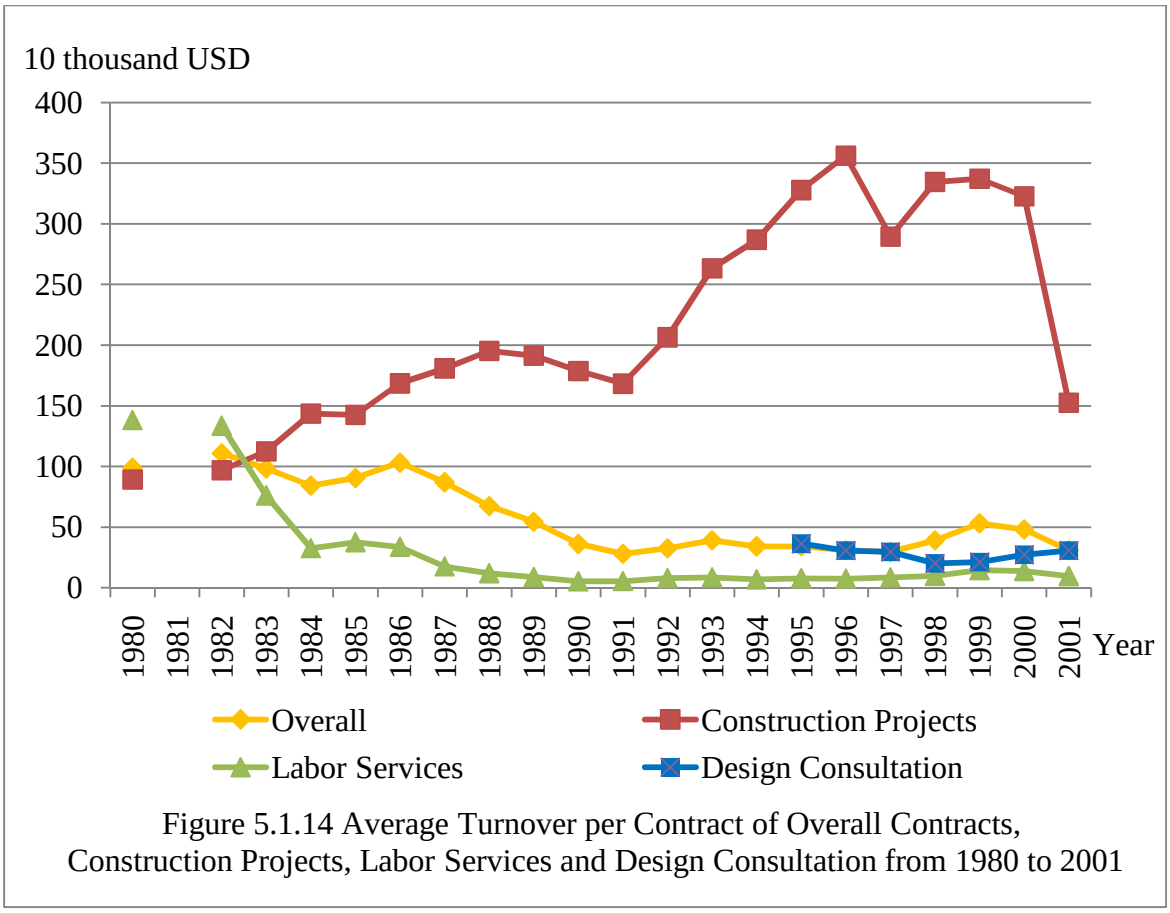

Figure 5.1.14 Average Turnover per Contract of Overall Contracts, Construction Projects, Labor Services and Design Consultation from 1980 to 2001

Note: Data for Design Consultation starts from 1995

Before 1986 the amount was larger, about 1 million USD per contract. At that time Chinese contractors worked primarily for overseas financial aid projects in the international market as mentioned in Chapter 3. These financial aid projects normally had a large amount of turnover per contract. The turnover per contract for labor service contracts followed the similar downward trend as the overall contracts. However, from 1982 to 1984 it dropped much more sharply because large labor services, which used to play a major role in Chinese overseas financial aid projects, were reduced. Since 1989 its average annual turnover per contract had not exceeded 0.1 million USD except in the years of 1999 and 2000. On the other hand, the average annual turnover per contract for the construction projects was growing in most of years during this

period. Since 1983, when it surpassed the average turnover of labor services, construction projects had always maintained a high level of average turnover compared with the other two contract types. From 1991 the construction projects became increasingly large in amount. The average annual turnover per construction project rose dramatically to the peak of 3.56 million USD in 1996, which was more than twice of the amount in 1991. Then this number remained stable between 2.8 and 3.5 million USD in the later years until a sharp drop to 1.52 million in 2001, because in 2001 the unit of construction projects increased by 125% while the total turnover value of construction projects only increased by 6%. As the smallest share in international contracts, the average turnover per design consultation contract was between 0.4 and 0.2 million.

5.1.2 Regions

Table 5.1.5 shows turnover in different regions classified based on types of contracts from 1998 to 2001. More than half of the turnover was fulfilled in the Asian market each year, while Africa was the second largest market with the proportion of about 15% of international contracts fulfilled by Chinese contractors.

Table 5.1.5 Turnover in Different Regions from 1998 to 2001

Region □ USD 10000□		Asia	Africa	Europe	Latin America	North America	Oceanic & Pacific Islands	Others	Inner Country	Total
1998	Construction Projects	532,231	187,064	23,880	10,376	11,107	9,969	3,625	146,064	924,316
	Labor Services	154,764	14,414	24,623	4,837	20,390	4,790	1,558	13,584	238,960
	Design Consultation	3,021	434	420	90	681	204	NA	9,197	14,047
	Total	690,016	201,912	48,923	15,303	32,178	14,963	5,183	168,845	1,177,323
	Percent in Total	58.6%	17.2%	4.2%	1.3%	2.7%	1.3%	0.4%	14.3%	100.0%
1999	Construction Projects	450,209	182,770	12,593	7,184	10,367	11,950	4,414	172,745	852,232
	Labor Services	171,100	20,312	17,102	6,969	22,534	6,250	1,429	16,572	262,268
	Design Consultation	3,410	547	921	213	187	21	8	3,651	8,958
	Total	624,719	203,629	30,616	14,366	33,088	18,221	5,851	192,968	1,123,458
	Percent in Total	55.6%	18.1%	2.7%	1.3%	2.9%	1.6%	0.5%	17.2%	100.0%
2000	Construction Projects	479,477	109,621	35,446	16,820	12,914	12,322	3,817	167,480	837,897
	Labor Services	191,227	18,514	18,398	6,293	23,312	4,253	3,432	15,827	281,256
	Design Consultation	2,960	586	395	103	195	41	NA	9,103	13,383
	Total	673,664	128,721	54,239	23,216	36,421	16,616	7,249	192,410	1,132,536
	Percent in Total	59.5%	11.4%	4.8%	2.0%	3.2%	1.5%	0.6%	17.0%	100.0%
2001	Construction Projects	466,288	152,406	56,367	26,284	24,542	10,487	3,990	149,593	889,957
	Labor Services	218,806	22,225	20,159	6,379	16,676	3,244	256	29,946	317,691
	Design Consultation	4,443	617	162	49	243	54	119	596	6,283
	Total	689,537	175,248	76,688	32,712	41,461	13,785	4,365	180,135	1,213,931
	Percent in Total	56.8%	14.4%	6.3%	2.7%	3.4%	1.1%	0.4%	14.8%	100.0%

Note: Adapted from the China Statistical Yearbooks 1999 through 2002

As presented in Figure 5.1.15, the total turnover fulfilled in the Asian market was between 6 and 7 billion USD from 1998 to 2001. As the largest proportion, construction projects accounted for about 72% of the turnover in average. The remaining proportion was almost entirely occupied by labor services with the average amount of about 2 billion USD per year. As to the design consultation, its turnover increased about 47% in 4 year period but never exceeded 45 million USD.

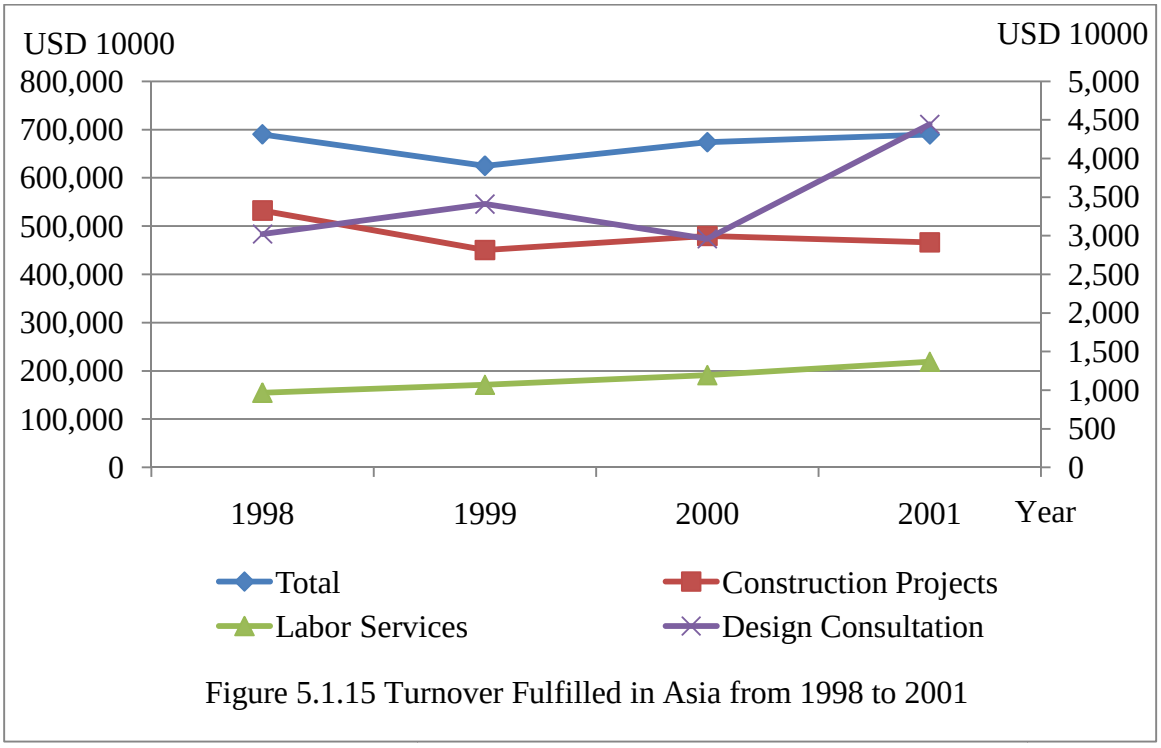

Figure 5.1.15 Turnover Fulfilled in Asia from 1998 to 2001

Note: Right scale shows Design Consultation; Left scale shows others.

The turnover fulfilled by Chinese contractors in Africa from 1998 to 2001 is shown in Figure 5.1.16. Africa was the second largest market for Chinese contractors in terms of turnover fulfilled during this period. In Africa, construction projects accounted for about 89% in average, 17% more than in Asia. The percentage of labor services was at about 10%. According to the results of data analysis, the average annual turnover per contract for construction projects was

the greatest from 1998 to 2001, about 24 times that of labor services. In addition, the proportion of large projects undertaken in Africa was higher than those in Asia.

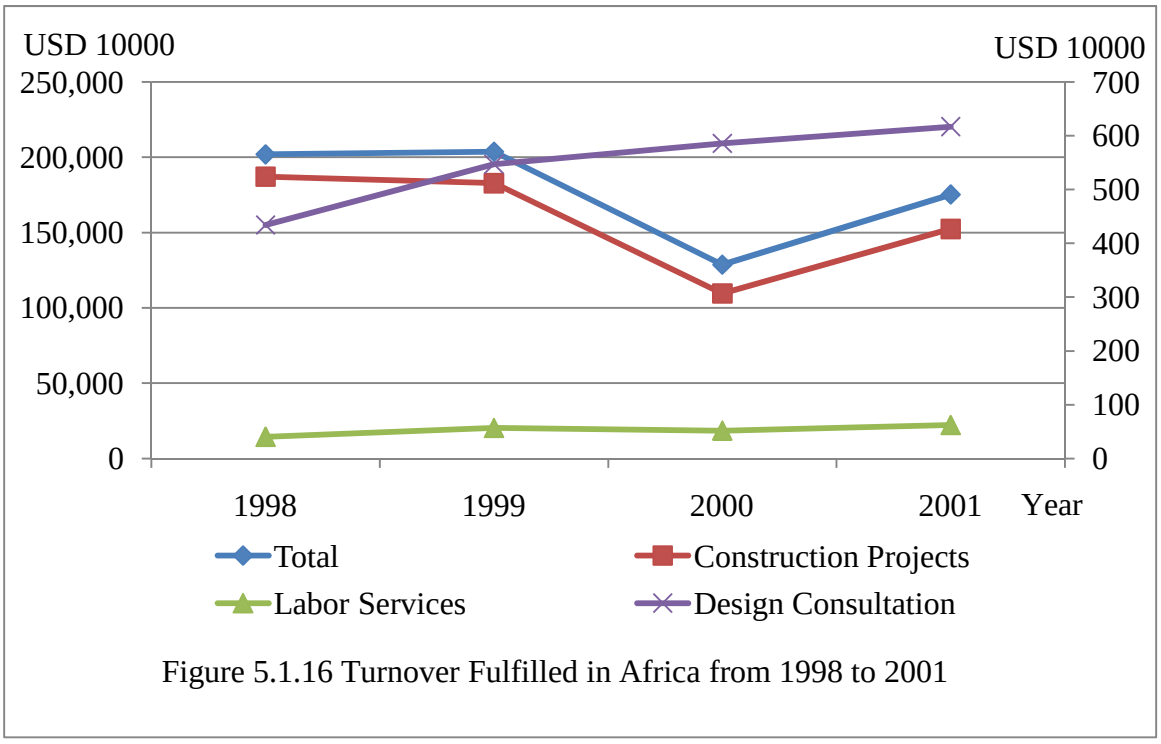

Figure 5.1.16 Turnover Fulfilled in Africa from 1998 to 2001

Note: Right scale shows Design Consultation; Left scale shows others.

The turnover fulfilled by Chinese contractors in Europe from 1998 to 2001 is presented in Figure 5.1.17. In the European market, the total turnover fulfilled by Chinese contractors was between 300 and 800 million USD each year during the four year period and had mounted continuously in the last two years which was the same trend as construction projects. On average, construction projects accounted for 61% of share and labor services took 38% of share. In 2001, the turnover of design consultation in Europe was only 1.62 million USD.

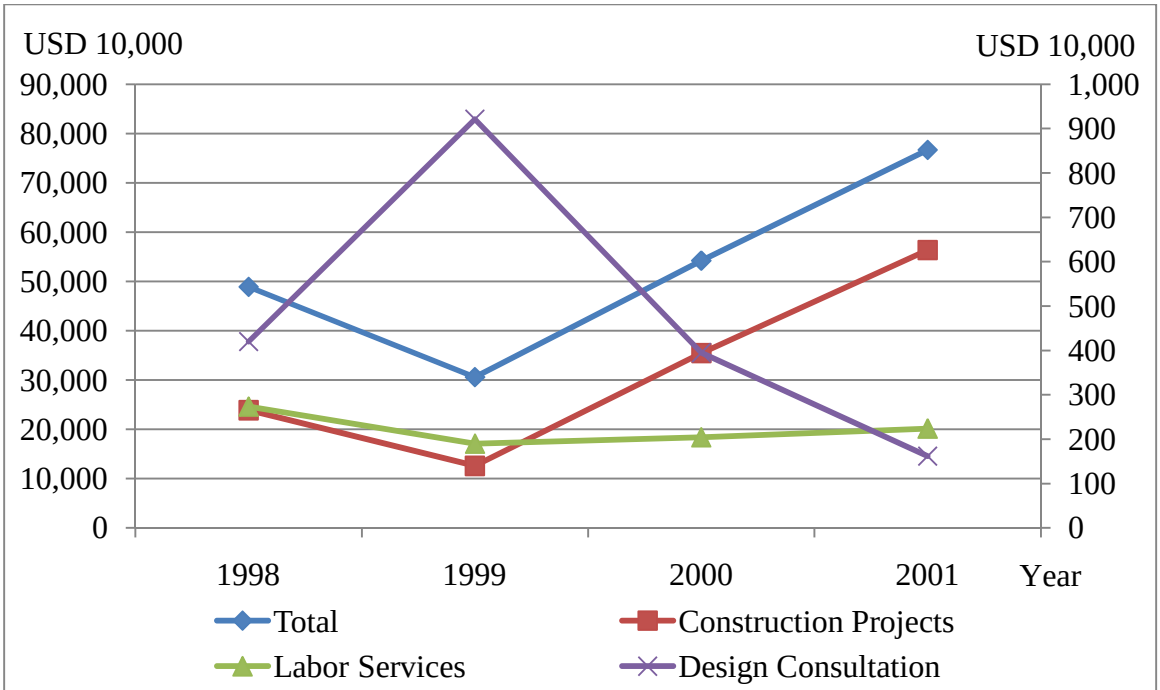

Figure 5.1.17 Turnover Fulfilled in Europe from 1998 to 2001

Note: Right scale shows Design Consultation; Left scale shows others.

As presented in Figure 5.1.18, the trend of turnover changing in Latin America was similar to the situation in Europe. In the last two years, the total turnover continuously increased, along with the turnover of construction projects which was the largest component in overall turnover fulfilled. The turnover of labor services was very stable at around 60 million USD each year. However, the design consultation declined to 0.49 million USD in 2001.

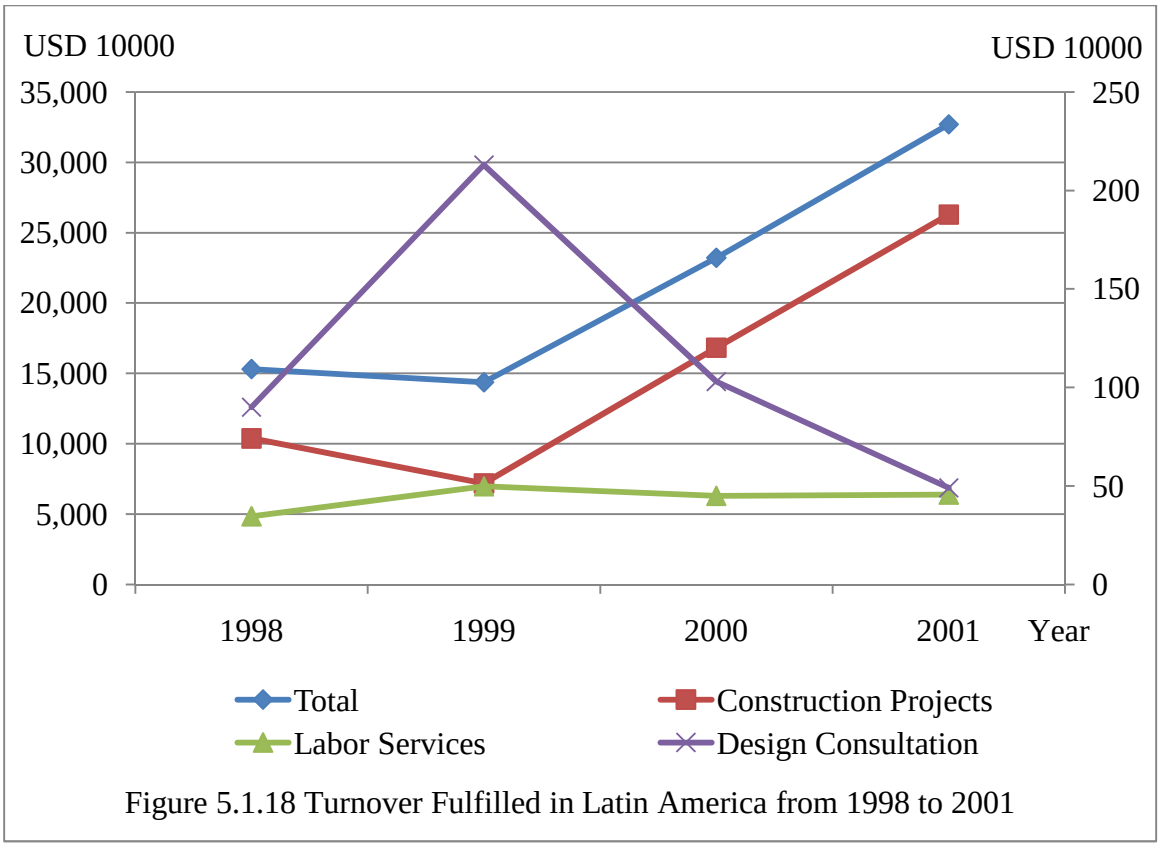

Figure 5.1.18 Turnover Fulfilled in Latin America from 1998 to 2001

Note: Right scale shows Design Consultation; Left scale shows others.

The turnover fulfilled by Chinese contractors in North America from 1998 to 2001 is shown in Figure 5.1.19. North America was the only market that the average turnover percentage of construction projects was less than that of labor services for the most of years during this period. However, the former surpassed the latter in the last year of 2001 by about 79 million USD. Overall, the total turnover in North America had an upward trend both on value and percentage.

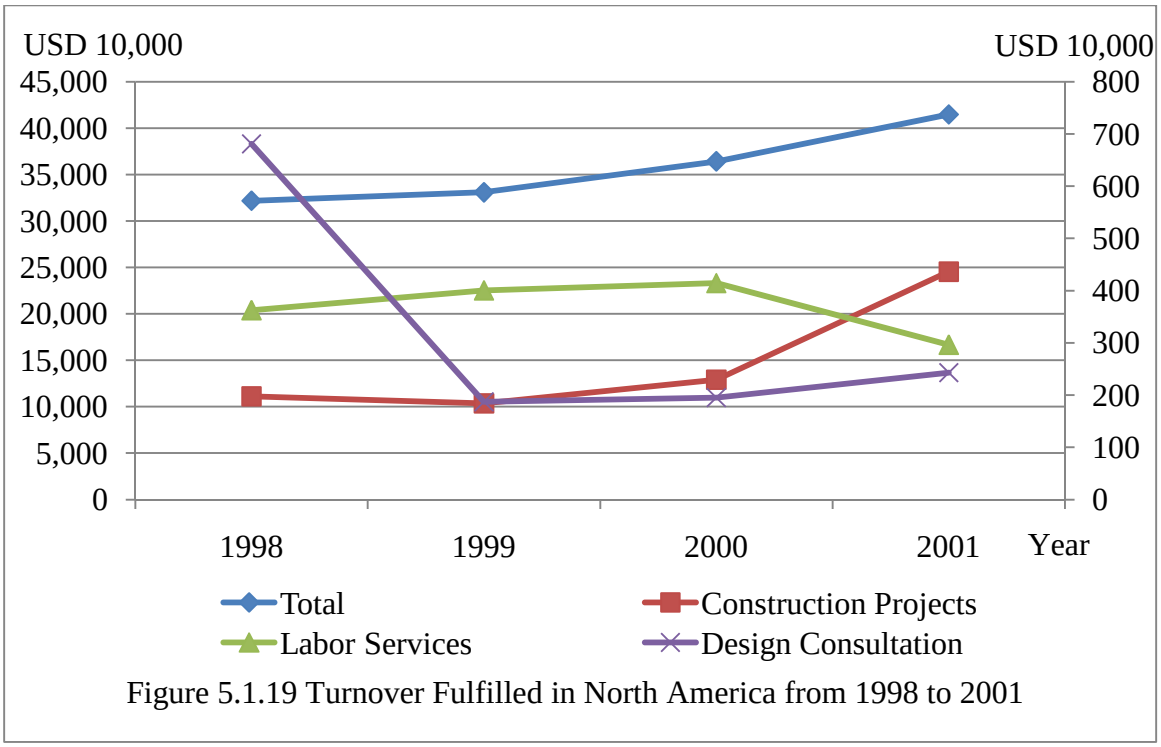

Figure 5.1.19 Turnover Fulfilled in North America from 1998 to 2001

Note: Right scale shows Design Consultation; Left scale shows others.

The turnover fulfilled by Chinese contractors in Oceanic & Pacific Islands from 1998 to 2001 is presented in Figure 5.1.20. In the Oceanic and Pacific Islands, the average turnover percentage for these four years was 1.4% of the total, which was the smallest over the six regions. Construction projects accounted for 70.3% of the total turnover on average while labor services occupied 29.2% of the total turnover. The total turnover declined continuously in the last 2 years.

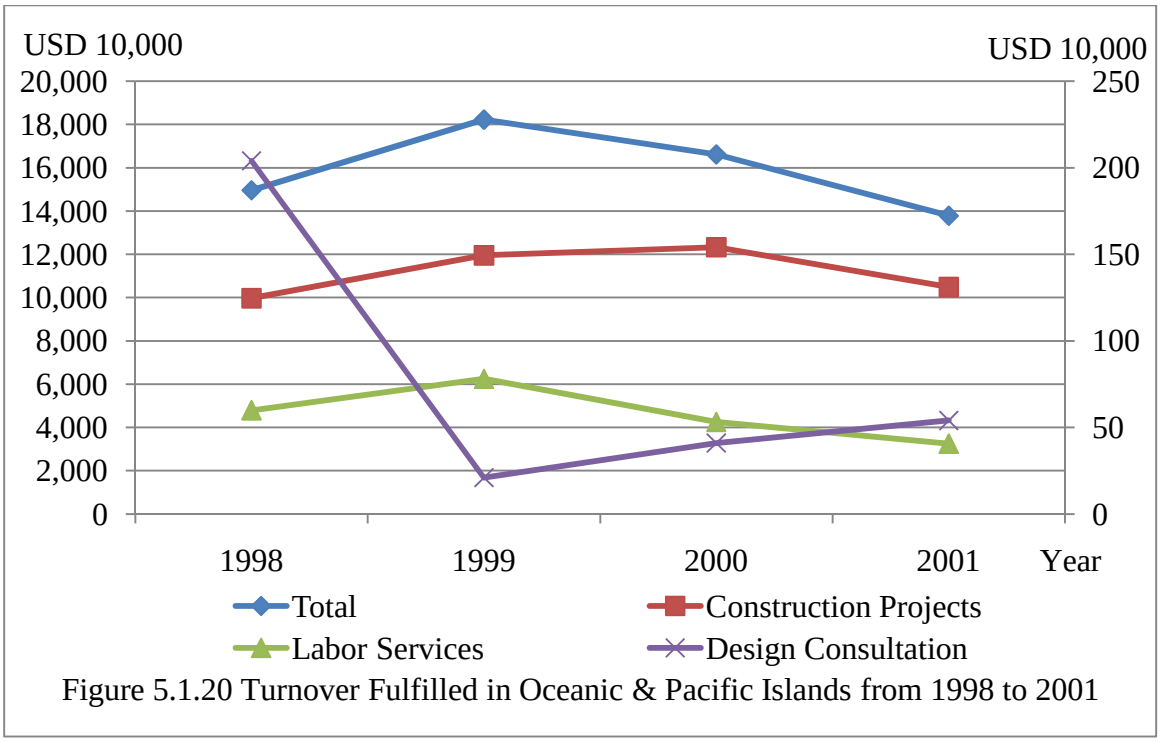

Figure 5.1.20 Turnover Fulfilled in Oceanic & Pacific Islands from 1998 to 2001

Note: Right scale shows Design Consultation; Left scale shows others.

Figure 5.1.21 presents the summary of the turnover changes in USD in all six regions from 1998 to 2001. Asia was the largest market in terms of turnover. Even at its bottom, it accounted for more than half of the total turnover for the Chinese contractors, which was above 6.2 billion USD. On the other hand, the average turnover and percentage each year in Africa, the second largest market, was about 1.77 billion USD and 15.3%, respectively. While the turnover fulfilled in the other four regions was less than 0.5 billion USD per year except for the years 2000 and 2001 in the Europe market.

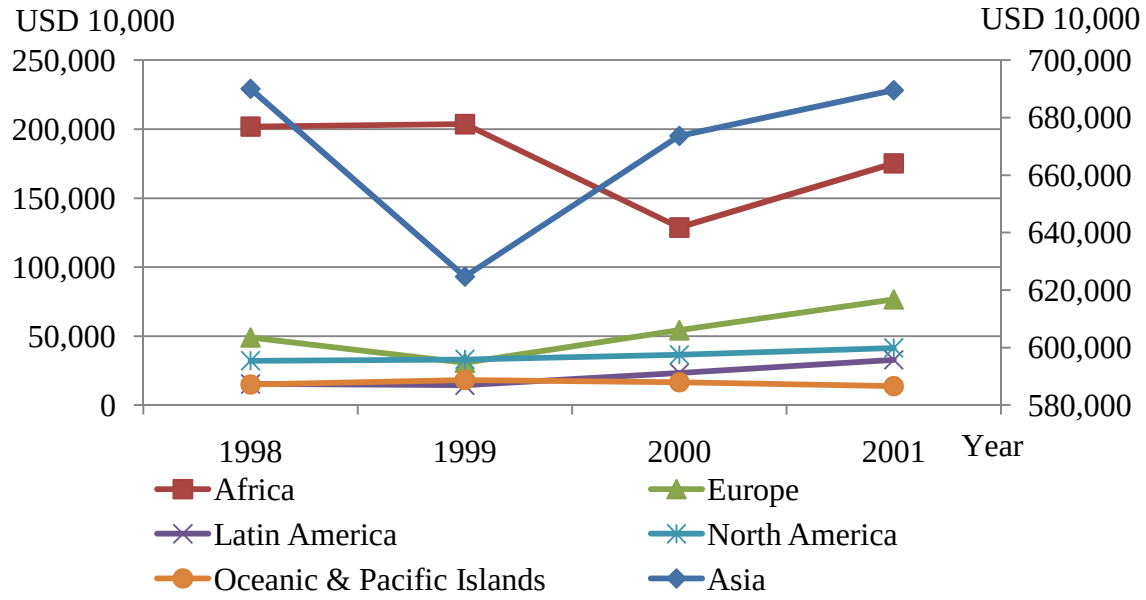

Figure 5.1.21 Turnover Fulfilled in Different Regions from 1998 to 2001

Note: Right scale shows Asia; Left scale shows others.

As illustrated in Figure 5.1.22, in the average of the four years, the combination of Asia and Africa was around 73% of the total turnover, while the other regions (except the regions of others and inner country) accounted for less than 11% of total turnover for the Chinese contractors. In 2001, the turnover percentage in Europe exceeded 6% of the total turnover, which was much higher than those of North America, Latin America, or Oceanic and Pacific Islands.

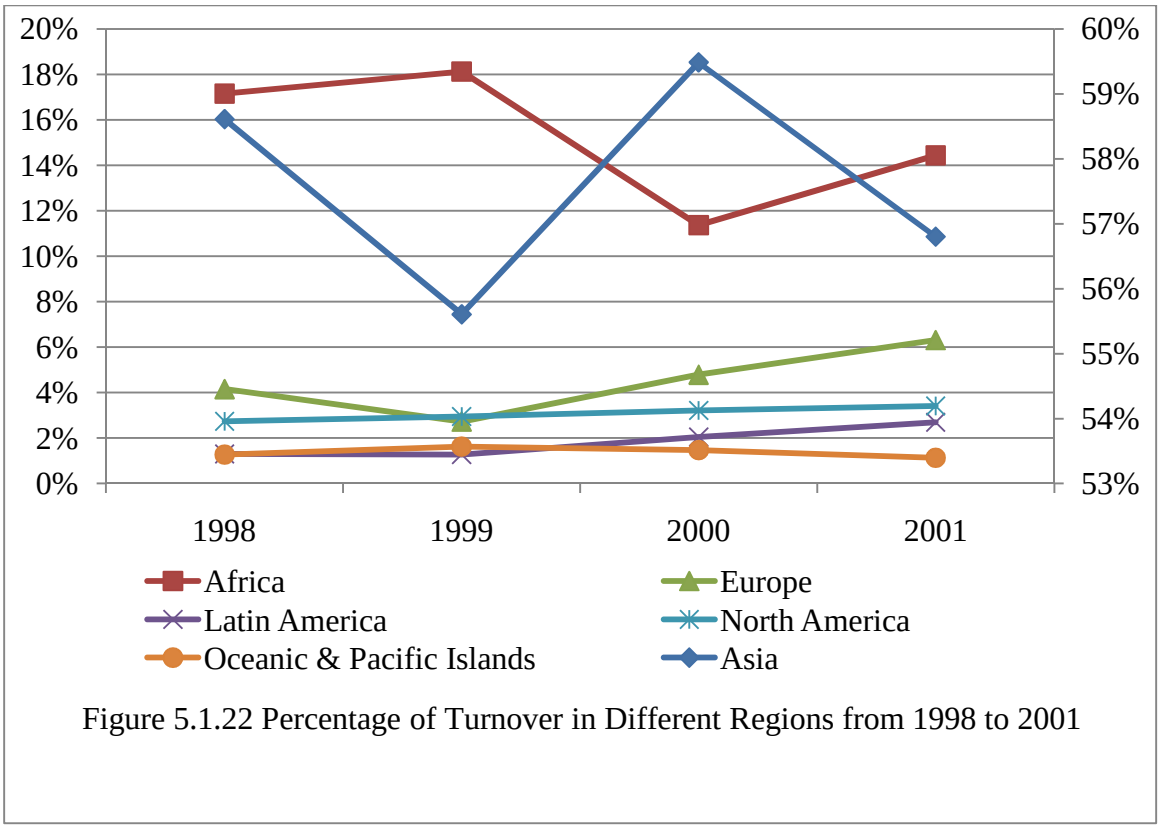

Figure 5.1.22 Percentage of Turnover in Different Regions from 1998 to 2001

Note: Right scale shows Asia; Left scale shows others.

5.1.3 Summary

Through the development of 22 years, by the end of 2001, the Chinese contractors had business in more than 180 countries or regions. The total number of overseas projects including construction projects, labor services and design consultation was about 40,000, increased by about 900 times. The contracting value reached about 16.5 billion USD, increased by about 300 times. The turnover surpassed 12 billion USD, increased by about 70 times. In terms of the average annual turnover per contract, the construction projects was growing in most of years from 1980 to 2001 and had turned to be the highest compared with labor services and design consultation since 1983. However, the average annual turnover per contract for labor services had a downward trend during the same period.

According to the regional distribution of Chinese overseas contracting business, Asia was the largest market that turnover was 72% of the total turnover in average. Although Africa was the second largest market for Chinese contractors, the proportion of large construction projects (with the largest average annual turnover per contract compared with labor services and design consultation) undertaken in Africa was higher than in Asia. Besides the Asian and African markets, Chinese overseas contracting business in other markets was relatively small at less than 11% of total turnover in average from 1998 to 2001.

5.2 Expansion from 2002 to 2008

5.2.1 Market Size

5.2.1.1 Number of Contracts

Table 5.2.1 shows the number of contracts that Chinese contractors had in foreign regions. Four components, construction projects, labor services, design consultation, and total contracts, were included in the table for each year.

Table 5.2.1 Number of Contracts from 2002 to 2008

Year	Number of Contracts by Types						
	Construction Projects		Labor Services		Design Consultation		Total Contracts (Unit)
	Unit	Percent	Unit	Percent	Unit	Percent	
2002	4,036	11.7%	30,163	87.5%	262	0.8%	34,461
2003	3,708	8.8%	38,043	90.5%	308	0.7%	42,059
2004	6,694	11.1%	53,271	88.3%	347	0.6%	60,312
2005	9,502	13.0%	63,410	86.6%	321	0.4%	73,233
2006	12,996	12.1%	94,386	87.6%	362	0.3%	107,744
2007	6,282	3.7%	161,457	96.0%	501	0.3%	168,240
2008	5,411	3.3%	157,682	96.2%	788	0.5%	163,881

Note: Adapted from the China Statistical Yearbook 2009

The total number of contracts kept on increasing during this period. In 2007, it reached 168,240 at its peak, followed by a slight drop in 2008 due to global economic recession. Overall, the total number of contracts mounted about 4.7 times during the seven year period as shown in Figure 5.2.1.

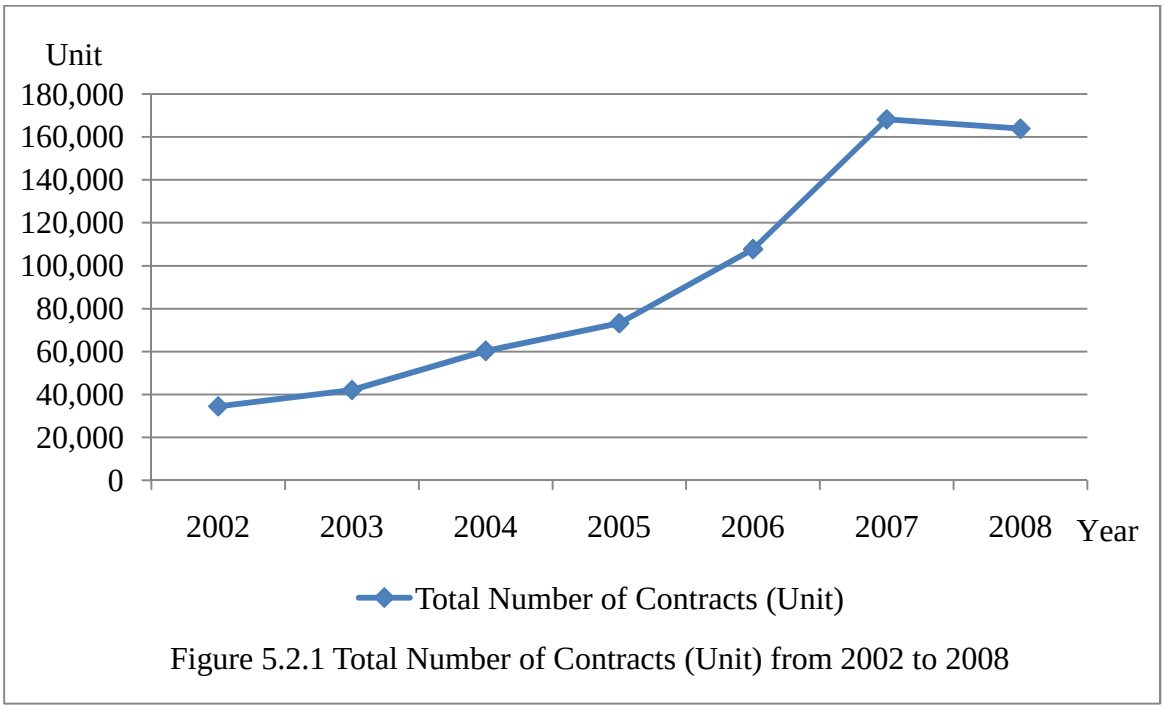

Figure 5.2.1 Total Number of Contracts (Unit) from 2002 to 2008

The number of construction projects in this period had increased since 2003 and peaked at 12,996 in 2006 as shown in Figure 5.2.2. Afterwards, it declined in two consecutive years. As to its percentage over total contracts, the percentage of construction projects dropped from about 11% in the beginning down to 3.3% in 2008. The number of construction projects was relatively small compared with the total number of contracts.

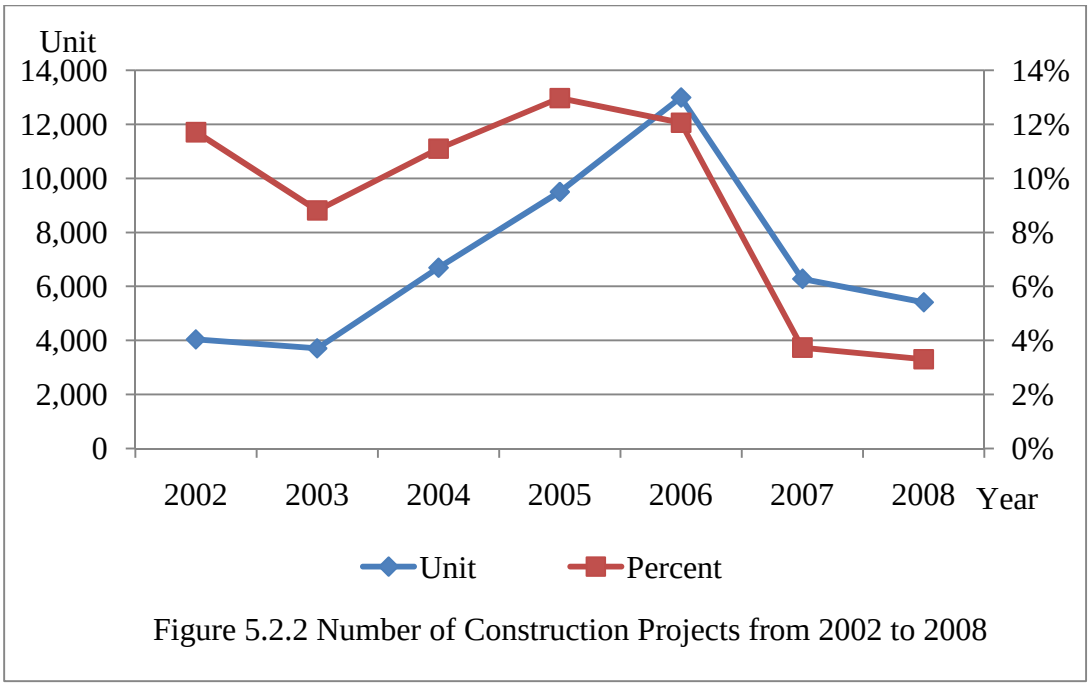

Figure 5.2.2 Number of Construction Projects from 2002 to 2008

Note: Left scale shows unit; Right scale shows percentage.

The number of labor service contacts kept on growing and had exceeded 150,000 in the last two years as shown in Figure 5.2.3, which accounted for more than 96% of the total number of contracts.

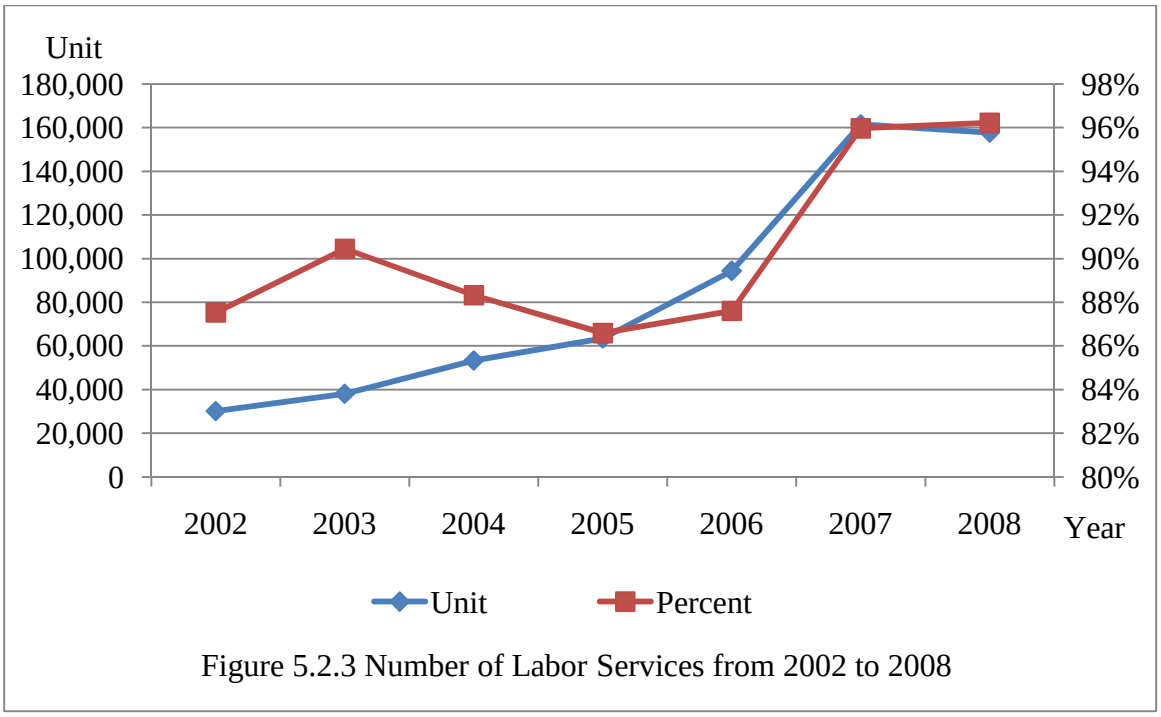

Figure 5.2.3 Number of Labor Services from 2002 to 2008

Note: Left scale shows unit; Right scale shows percentage.

The number of design consultation contracts had an upward trend during this period and peaked at 788 in 2008, which was 3 times the number in 2002 as shown in Figure 5.2.4. However, its percentage in the total number of contacts declined in most years except the year of 2008 when it rebound from 0.3% to 0.5%. In short, compared with construction and labor service contracts, the number of design consultation contracts was too insignificant for Chinese contractors.

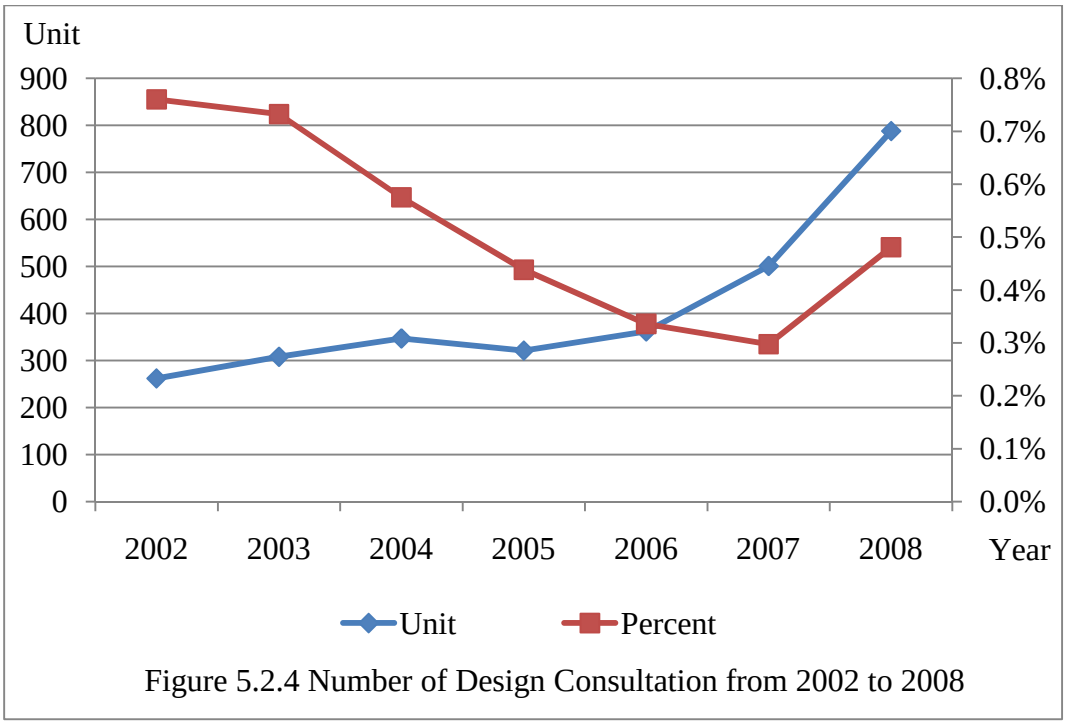

Figure 5.2.4 Number of Design Consultation from 2002 to 2008

Note: Left scale shows unit; Right scale shows percentage.

Figure 5.2.5 clearly illustrated the changes in the numbers of contracts for construction projects, labor services, and design consultation. For labor services, it had the absolute advantage in the number of international contracts and had significant growth rate during this period. For construction projects, its number was relatively stable except reaching the peak in 2006. Although in 2008 the number of design consultation contracts increased about two times compared with the number in 2002, it equaled only about 0.5% of the number of labor service contracts in the same year.

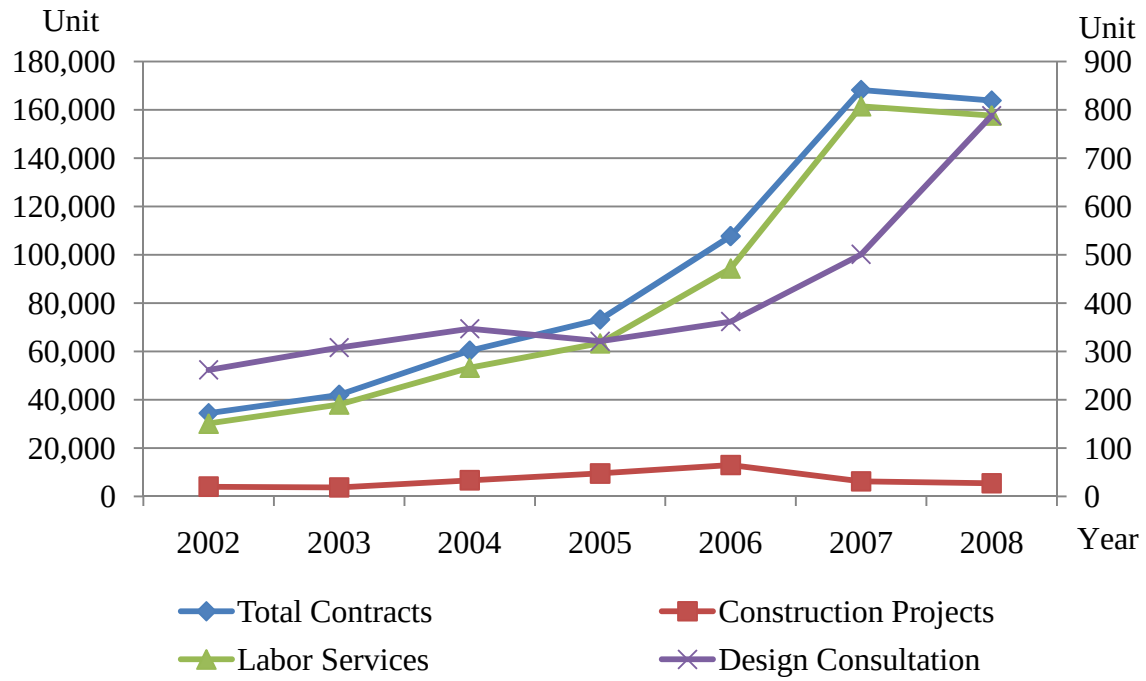

Figure 5.2.5 Number of Total Contracts, Construction Projects, Labor Services and Design Consultation from 2002 to 2008

Note: Right scale shows Design Consultation; Left scale shows others.

5.2.1.2 Contracting Value

Table 5.2.2 shows the contracting value of construction projects, labor services and design consultation each year from 2002 to 2008.

Table 5.2.2 Contracting Value from 2002 to 2008

Year	Contracting Value by Types (100 million USD)						
	Construction Projects		Labor Services		Design Consultation		Total Contracts
	Value	Percent	Value	Percent	Value	Percent	
2002	150.55	84.1%	27.52	15.4%	0.8	0.5%	178.91
2003	176.67	84.4%	30.87	14.7%	1.8	0.8%	209.30
2004	238.44	86.1%	35.03	12.6%	3.5	1.3%	276.98
2005	296.14	86.6%	42.45	12.4%	3.6	1.0%	342.16
2006	660.05	92.1%	52.33	7.3%	4.1	0.6%	716.48
2007	776.21	90.9%	66.99	7.8%	10.3	1.2%	853.45
2008	1,045.62	92.5%	75.64	6.7%	8.9	0.8%	1,130.15

Note: Adapted from the China Statistical Yearbook 2009

As presented in Figure 5.2.6, the total contracting value was increasing during the entire period. It started from 17.9 billion USD in 2002 and increased by 5.3 times to 113 billion USD in 2008.

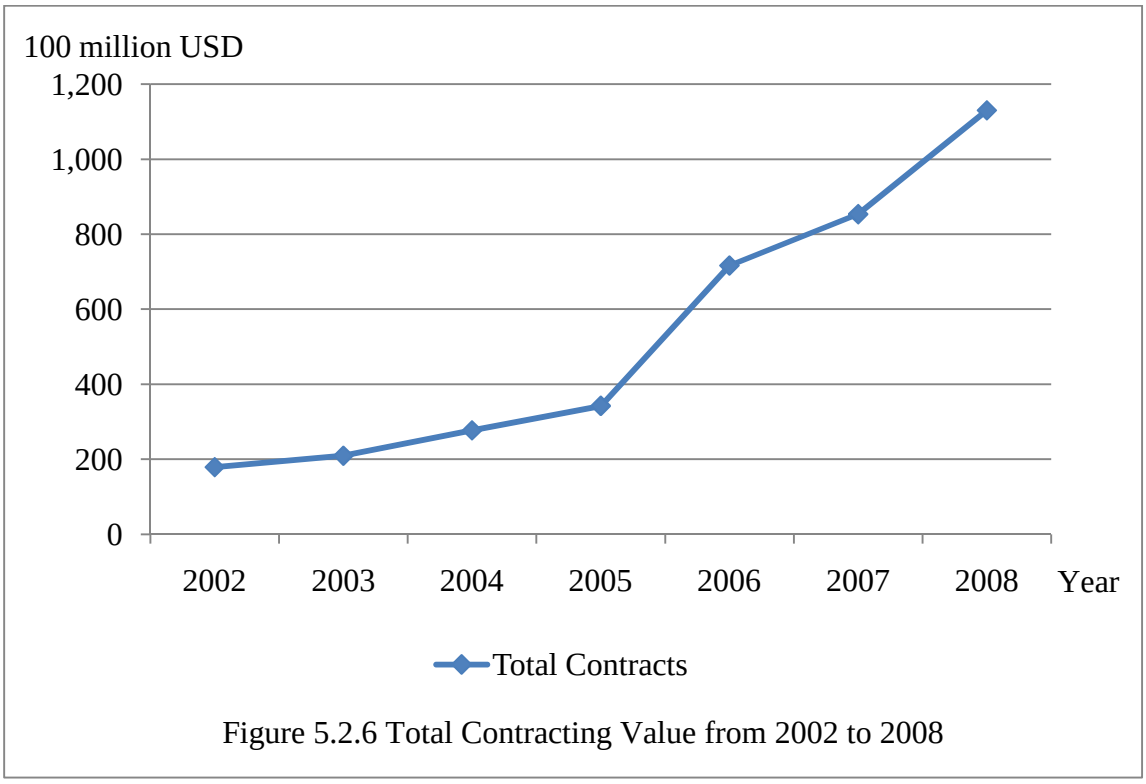

Figure 5.2.6 Total Contracting Value from 2002 to 2008

The contracting value of construction projects continued growing during this period. In the end of the current period, it exceeded 100 billion USD which accounted for 92.5% of total contracting value as shown in Figure 5.2.7.

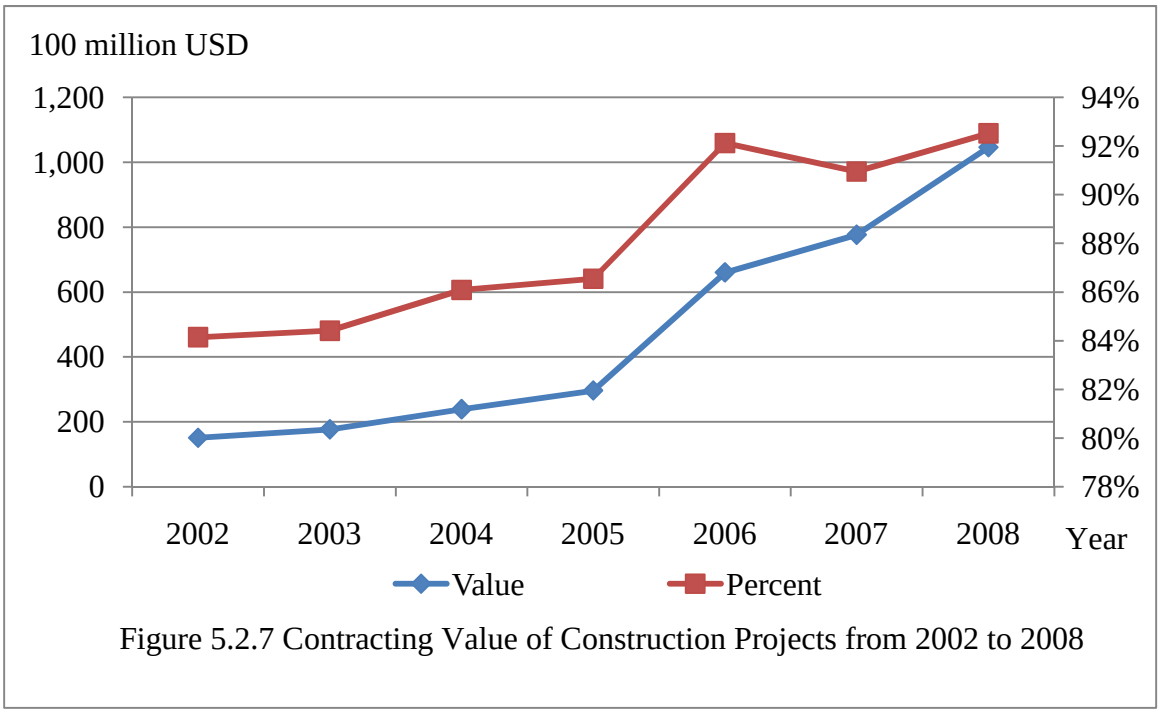

Figure 5.2.7 Contracting Value of Construction Projects from 2002 to 2008

Note: Left scale shows value; Right scale shows percentage.

Although the contracting value of labor services increased constantly from about 2.8 billion USD to 7.5 billion USD during this period, its percentage in total contracting value declined by more than half from 15.4% to 6.7% as shown in Figure 5.2.8. Obviously, the speed of its growth was not as fast as that of construction projects.

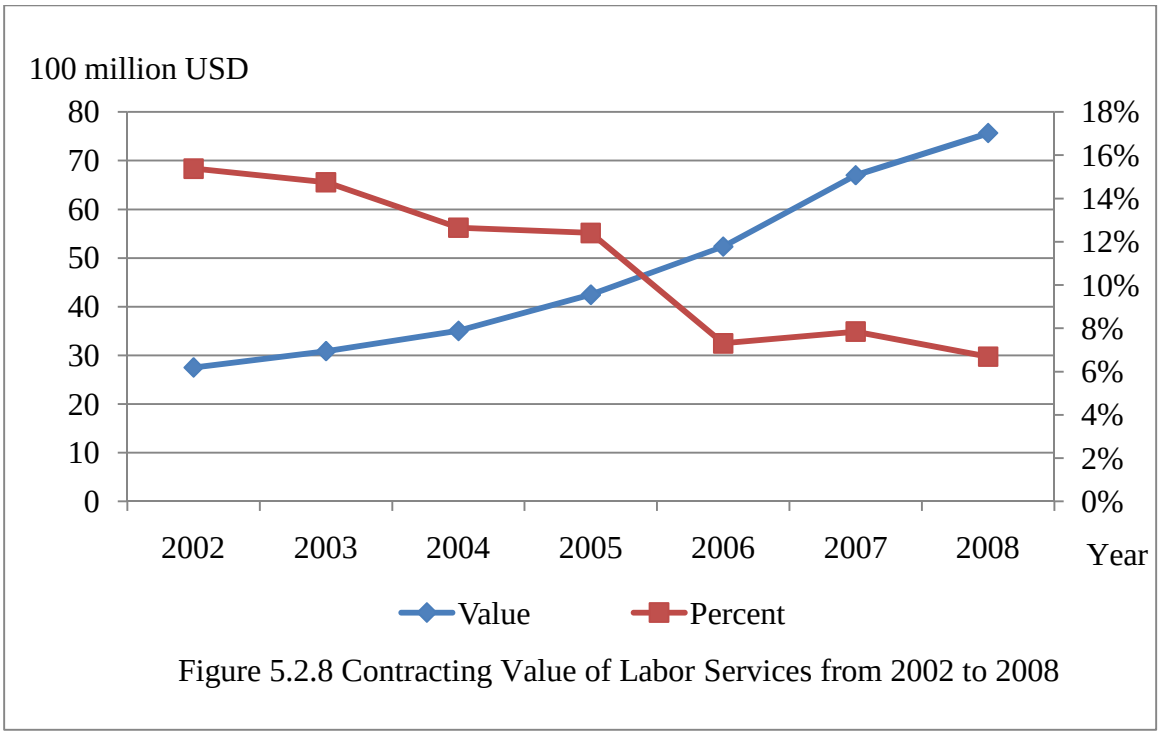

Figure 5.2.8 Contracting Value of Labor Services from 2002 to 2008

Note: Left scale shows value; Right scale shows percentage.

Overall, the contracting value of design consultation increased by about 10 times during this period and peaked in 2007 when its value exceeded 1 billion USD in the first time, as presented in Figure 5.2.9. However, its percentage in total contracting value was still extremely low. With the high speed growth of construction projects, the average percentage of contracting value of design consultation even decreased by 50% compared with that of the previous period.

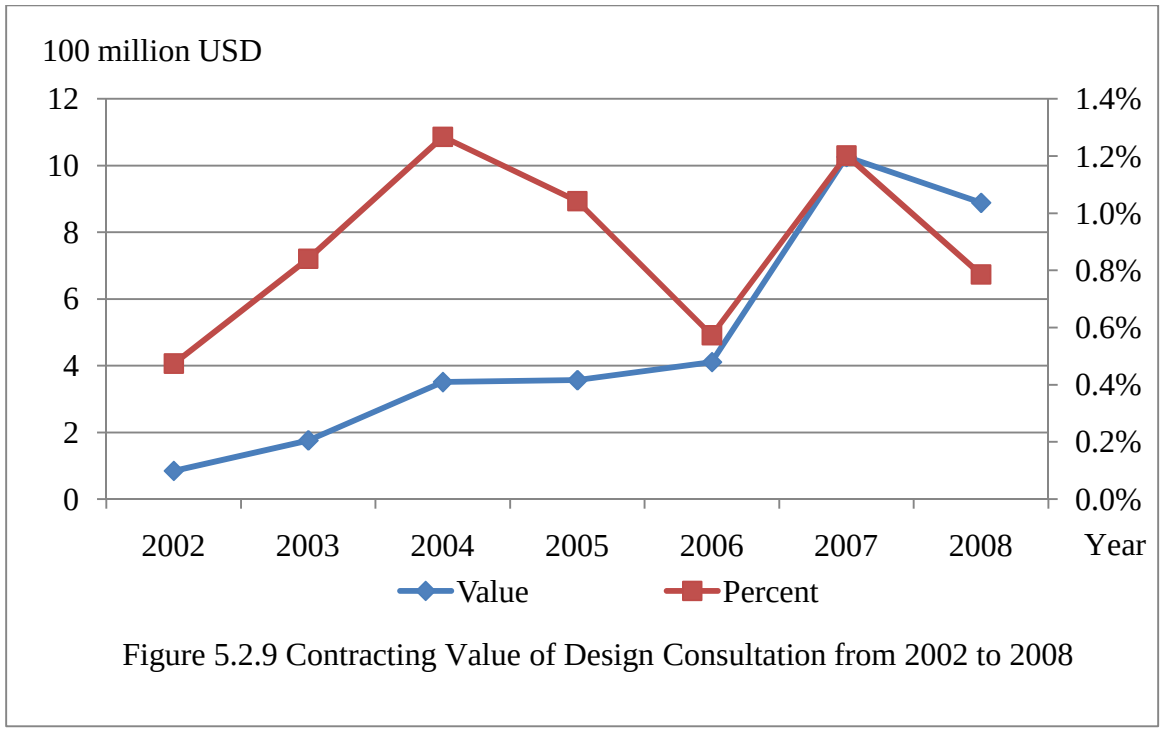

Figure 5.2.9 Contracting Value of Design Consultation from 2002 to 2008

Note: Left scale shows value; Right scale shows percentage.

Figure 5.2.10 presents the summary of the trends of contracting value in each business sector from 2002 to 2008. In comparison with their own starting points, both construction projects and design consultation increased dramatically during this period, although the later dropped slightly in 2008. As for labor services, its contracting value grew slowly each year.

Figure 5.2.10 Contracting Value of Overall Contracts, Construction Projects, Labor Services and Design Consultation from 2002 to 2008

Note: Right scale shows Design Consultation; Left scale shows others.

5.2.1.3 Turnover Fulfilled

Table 5.2.3 shows the turnovers of Chinese contractors from 2002 to 2008 based on value and percentage.

Table 5.2.3 Turnover Fulfilled from 2002 to 2008

Year	Turnover Fulfilled by Types (100 million USD)						
	Construction Projects		Labor Services		Design Consultation		Total Contracts
	Value	Percent	Value	Percent	Value	Percent	
2002	111.94	78.0%	30.71	21.4%	0.87	0.6%	143.52
2003	138.37	80.3%	33.09	19.2%	0.88	0.5%	172.34
2004	174.68	81.7%	37.53	17.6%	1.47	0.7%	213.69
2005	217.63	81.3%	47.86	17.9%	2.27	0.8%	267.76
2006	299.93	84.0%	53.73	15.1%	3.29	0.9%	356.95
2007	406.43	84.8%	67.67	14.1%	4.90	1.0%	479.00
2008	566.12	86.9%	80.57	12.4%	4.48	0.7%	651.16

Note: Adapted from the China Statistical Yearbook 2009

The total value of turnover fulfilled from 2002 to 2008 was increasing constantly during this period, as illustrated in Figure 5.2.11. Within seven years, it grew more than 3.5 times and reached 65.1 billion USD in 2008 from 14.4 billion USD in 2002. A cubic polynomial curve can be developed to accurately match its change during this period ($R^2 = 1$). The polynomial function of total value of turnover fulfilled is:

$$y = 1.6035x^3 - 5.0697x^2 + 33.776x + 113.04 \quad (5.1)$$

where

x = year

y = total value of turnover fulfilled in 100 million USD.

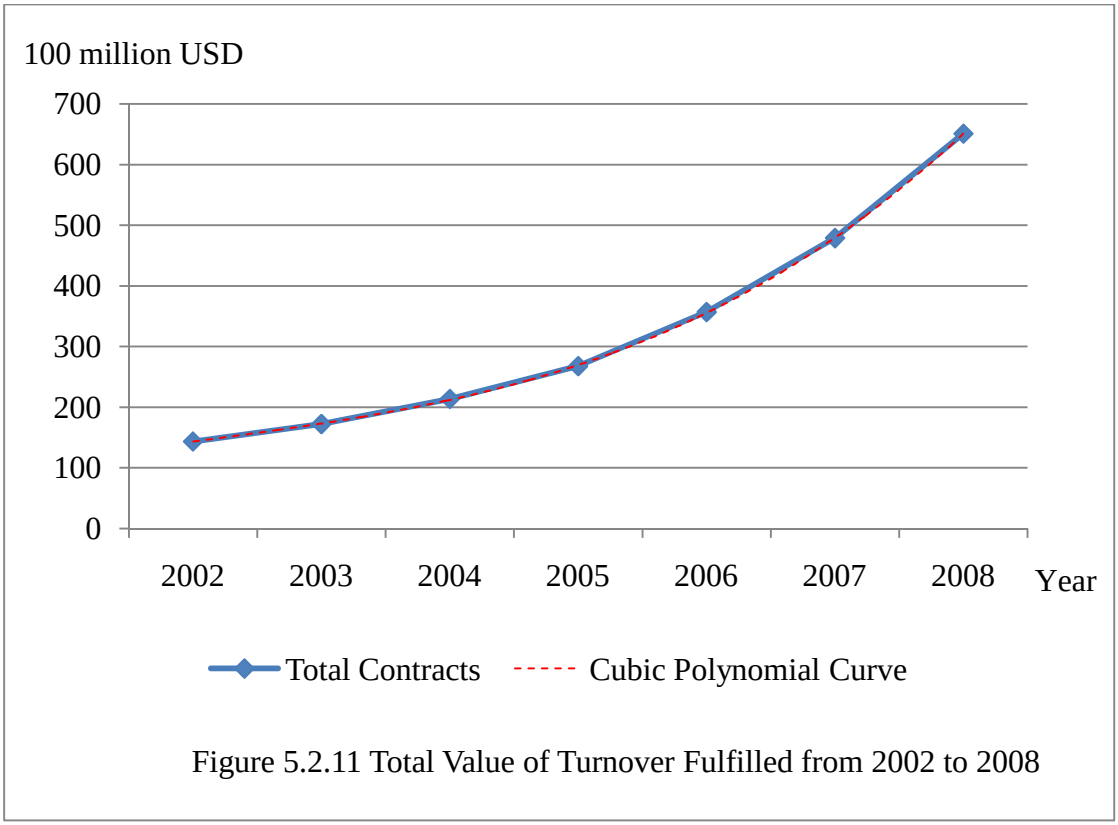

Figure 5.2.11 Total Value of Turnover Fulfilled from 2002 to 2008

The turnover of construction projects maintained growth in this period. It increased from 11.2 billion USD in 2002 to 56.6 billion USD in 2008 as shown in Figure 5.2.12. A cubic

polynomial curve can be generated to accurately describe its change during this period (R^2 = 0.9998). The polynomial function of turnover fulfilled of construction projects is:

$$y = 1.691x^3 - 7.2458x^2 + 37.242x + 80.137 \quad (5.2)$$

where

x = year

y = turnover fulfilled of construction projects in 100 million USD.

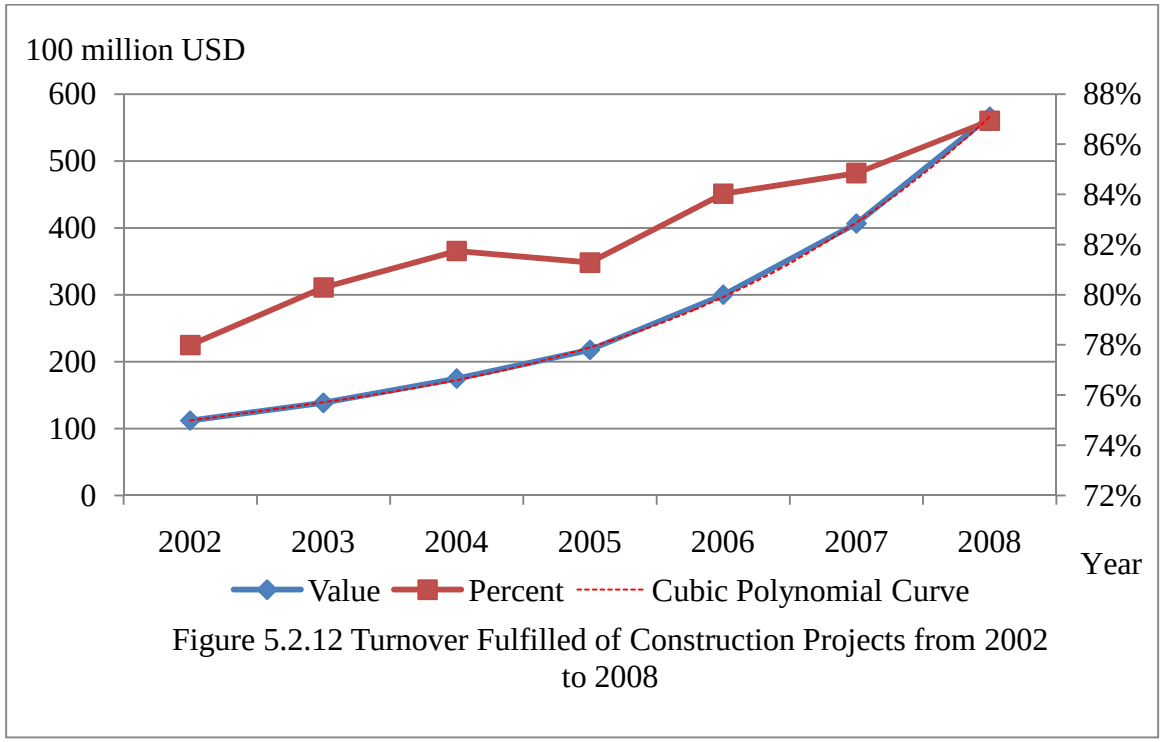

Figure 5.2.12 Turnover Fulfilled of Construction Projects from 2002 to 2008

Note: Left scale shows value; Right scale shows percentage.

On the other hand, the turnover percentage of construction projects in overall international contracts increased in most years except for the year of 2005, and exceeded 86% at the end of this period.

With the growth of proportion of construction projects in total turnover, the proportion of labor services in total turnover declined correspondingly as presented in Figure 5.2.13. In 2002,

the proportion of labor services was 21.4%, but at the end of this period the proportion of labor services was12.4% in total turnover.

As to its absolute value, labor services experienced a quadratic polynomial increase. It started from about 3.1 billion USD and mounted to the peak of about 8.1 billion USD. A polynomial function can be developed to represent the turnover fulfilled of labor services (R^2 = 0.996):

$$y = 1.086x^2 - 0.2974x + 29.636 \quad (5.3)$$

where

x = year

y = turnover fulfilled of labor services in 100 million USD.

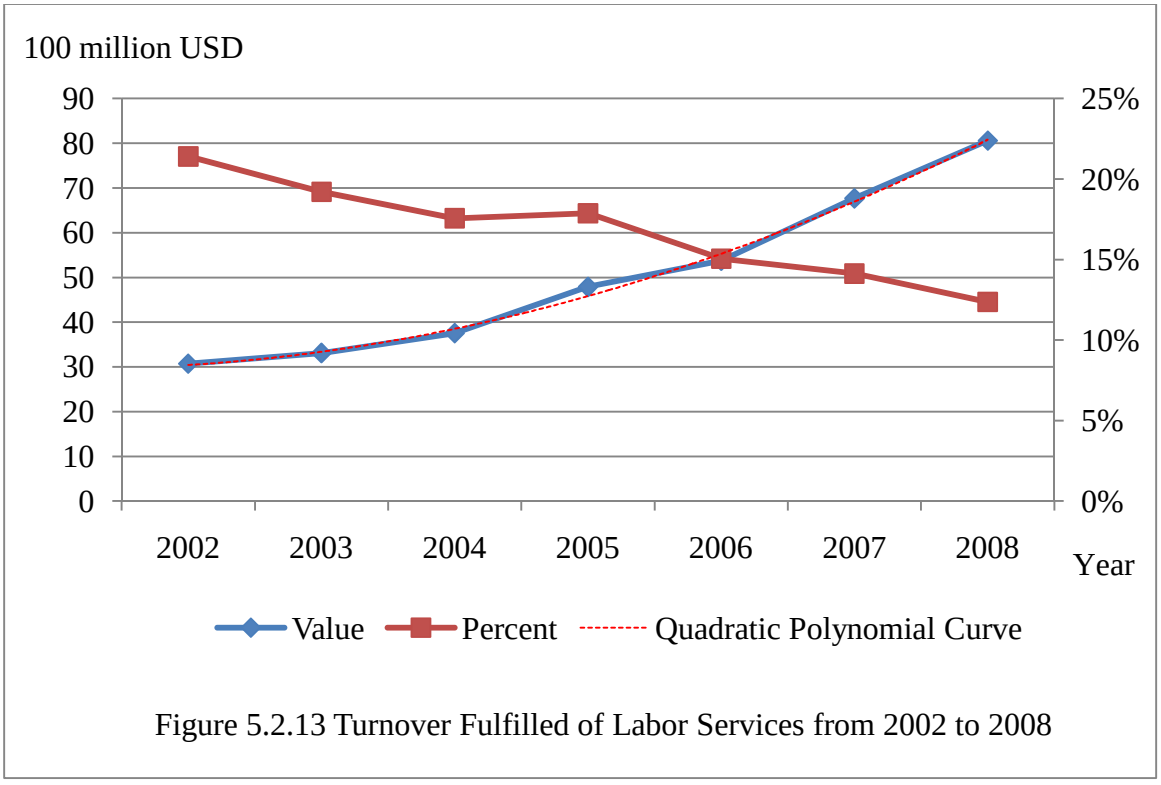

Figure 5.2.13 Turnover Fulfilled of Labor Services from 2002 to 2008

Note: Left scale shows value; Right scale shows percentage.

During this period, the turnover value of design consultation was still very low compared with construction projects and labor services. Although the absolute value, which never exceeded 200 million in the previous period, reached 490 and 448 million USD in the last two years. In 2008 the turnover fulfilled of design consultation only accounted for 0.7% of the total turnover fulfilled as shown in Figure 5.2.14.

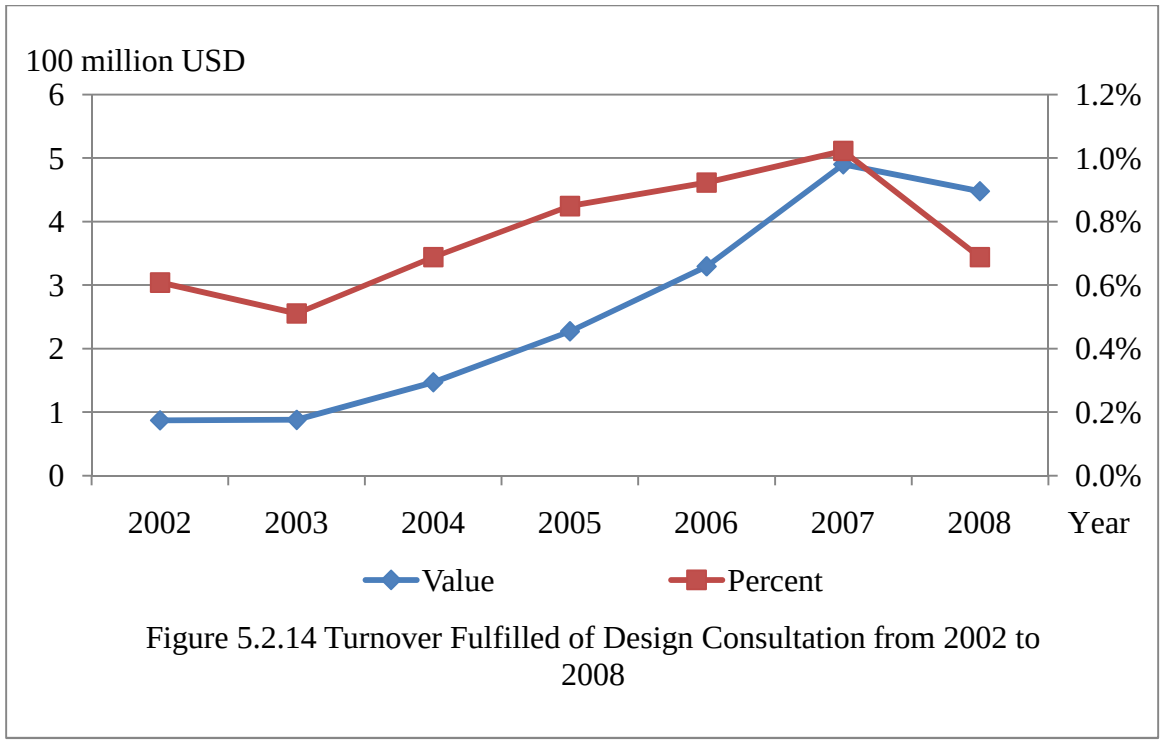

Figure 5.2.14 Turnover Fulfilled of Design Consultation from 2002 to 2008

Note: Left scale shows value; Right scale shows percentage.

Figure 5.2.15 presents the summary of turnover fulfilled for different types of projects after China entered the WTO in 2001. The proportion of construction projects continued increasing and approached to 90% of total turnover fulfilled, while labor services occupied less and less. For design consultation, it was too small to identify.

Figure 5.2.15 Turnover Fulfilled for Different Types of Projects from 2002 to 2008

5.2.1.4 Average Turnover per Contract

Table 5.2.4 presents the average annual turnover per contract for construction projects, labor service projects and design consultation projects.

Table 5.2.4 Average Turnover per Contract from 2002 to 2008

Average Turnover per Contract (10 thousand USD)				
Year	Construction Projects	Labor Services	Design Consultation	Overall
2002	277.34	10.18	33.29	41.65
2003	373.17	8.70	28.57	40.98
2004	260.95	7.05	42.36	35.43
2005	229.04	7.55	70.78	36.56
2006	230.78	5.69	91.00	33.13
2007	646.97	4.19	97.77	28.47
2008	1,046.23	5.11	56.82	39.73

Note: Adapted from the China Statistical Yearbook 2009

Compared with other three curves, the average annual turnover per contract of overall international contracts remained relatively stable in this period as shown in Figure 5.2.16. Although it decreased by 14.1% to 284,700 USD per contract in 2007, it recovered by 40% to about 400,000 USD per contract in 2008, almost equal to the beginning value in 2002. As for the labor service project, its average annual turnover per contract declined by about 50% in total from 2002 to 2008. Meanwhile construction projects fluctuated slightly from 2002 to 2006, followed by two consecutive sharp growths in the years of 2007 and 2008; especially in 2008, its average annual turnover per contract exceeded 10 million USD for the first time, which was almost four times of that in 2002. For design consultation, it increased constantly from 285.7 thousand USD in 2003 to 977.7 thousand USD in 2007 with an average growth rate of 37.85%. However, in 2008 it dropped sharply by 41.9% to 568.2 thousand USD.

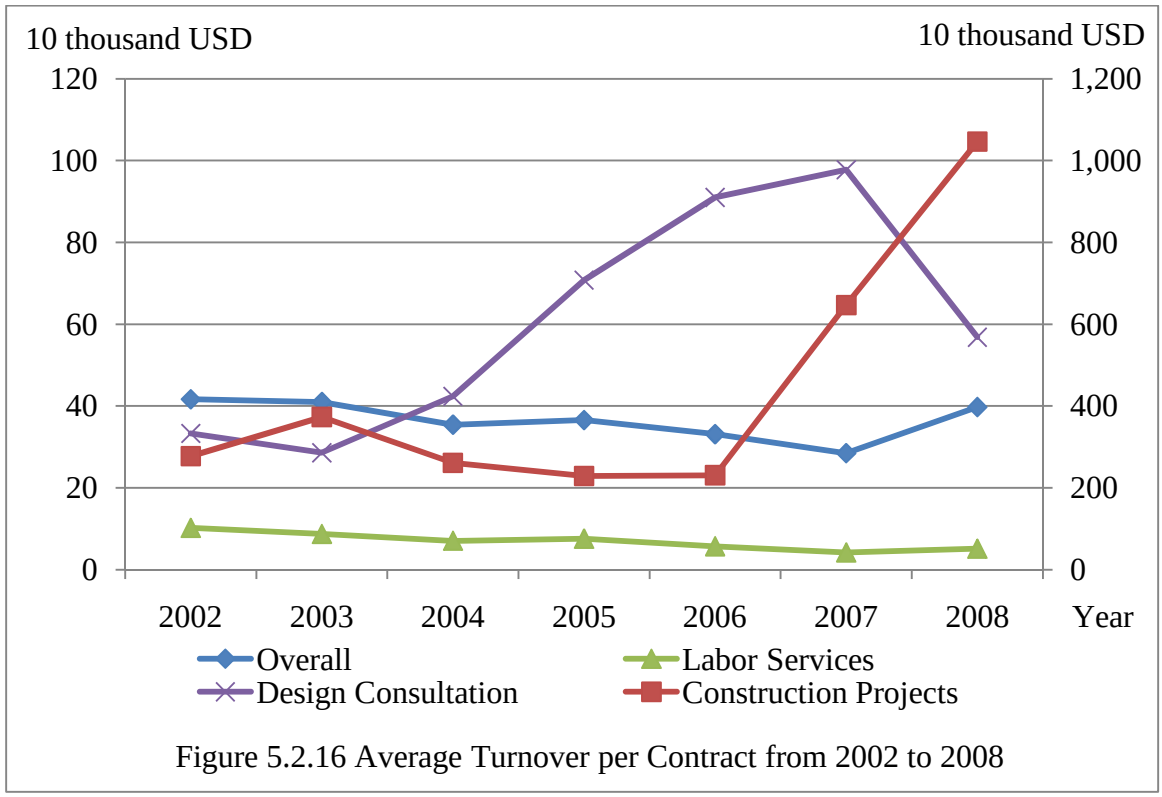

Figure 5.2.16 Average Turnover per Contract from 2002 to 2008

Note: Right scale shows Construction Projects; Left scale shows others.

Overall, the average annual turnover per contract of construction projects was the largest, between 2 and 11 million USD per contract, while that of labor services was the smallest, between 0.04 and 0.1 million per contract. Although the total volume of design consultation was insignificant compared with other two sectors, in 2007 its average annual turnover per contract was more than 20 times of that of labor services.

5.2.2 Regions

Table 5.2.5 shows the turnover of Chinese contractors in different regions from 2002 to 2008. During this period, the total turnover was about 32.6 billion USD per year on average (construction projects 83.8%, labor services 15.4%, design consultation 0.8%). As for different regions, Asia accounted for 49.8% at 16.1 billion USD, Africa accounted for 22.4% at 8.2 billion USD, Europe accounted for 8.3% at 2.6 billion USD, Latin America accounted for 4.7% at 1.6 billion USD, North America accounted for 2.5% at 0.7 billion USD, and Oceanic & Pacific Islands accounted for 0.8% at 0.3 billion.

Table 5.2.5 Turnover of International Contracts from 2002 to 2008

Region □ USD 10000□		Asia	Africa	Europe	Latin America	North America	Oceanic & Pacific Islands	Others	Inner Country	Total
2002	Construction Projects	573,791	181,357	90,931	34,722	57,304	9,116	19,025	153,112	1,119,358
	Labor Services	203,360	19,579	17,801	6,197	14,423	3,057	1,099	41,625	307,141
	Design Consultation	3,548	1,359	2,007	35	465	43	394	872	8,723
	Total	780,699	202,295	110,739	40,954	72,192	12,216	20,518	195,609	1,435,222
	Percent in Total	54.4%	14.1%	7.7%	2.9%	5.0%	0.9%	1.4%	13.6%	100.0%
2003	Construction Projects	692,664	260,125	116,053	64,800	16,105	5,564	27,309	201,116	1,383,736
	Labor Services	208,131	22,256	25,042	6,090	14,529	2,979	232	51,622	330,881
	Design Consultation	3,073	888	431	27	278	77	129	3,873	8,776
	Total	903,868	283,269	141,526	70,917	30,912	8,620	27,670	256,611	1,723,393
	Percent in Total	52.4%	16.4%	8.2%	4.1%	1.8%	0.5%	1.6%	14.9%	100.0%
2004	Construction Projects	814,158	381,310	139,367	80,789	24,872	9,474	8,055	288,804	1,746,829
	Labor Services	229,675	18,231	25,049	6,548	12,265	1,976	362	81,223	375,329
	Design Consultation	6,862	2,472	53	33	23	10	178	5,109	14,740
	Total	1,050,695	402,013	164,469	87,370	37,160	11,460	8,595	375,136	2,136,898
	Percent in Total	49.2%	18.8%	7.7%	4.1%	1.7%	0.5%	0.4%	17.6%	100.0%
2005	Construction Projects	931,788	609,222	213,281	141,309	43,246	7,035	8,895	221,548	2,176,324
	Labor Services	259,950	15,388	29,809	5,204	8,806	1,970	58,342	99,091	478,560
	Design Consultation	15,320	2,808	1,971	225	73	96	44	2,184	22,721
	Total	1,207,058	627,418	245,061	146,738	52,125	9,101	67,281	322,823	2,677,605
	Percent in Total	45.1%	23.4%	9.2%	5.5%	1.9%	0.3%	2.5%	12.1%	100.0%
2006	Construction Projects	1,377,173	932,406	342,337	191,296	120,856	30,681	4,532	NA	2,999,281
	Labor Services	300,661	15,198	37,261	5,188	7,686	1,373	163	169,744	537,274
	Design Consultation	21,401	7,329	1,464	558	98	64	101	1,927	32,942
	Total	1,699,235	954,933	381,062	197,042	128,640	32,118	4,796	171,671	3,569,497
	Percent in Total	47.6%	26.8%	10.7%	5.5%	3.6%	0.9%	0.1%	4.8%	100.0%
2007	Construction Projects	2,035,295	1,237,608	358,596	287,786	98,526	41,838	4,609	NA	4,064,258
	Labor Services	316,754	21,650	47,079	3,565	8,302	1,459	163	277,740	676,712
	Design Consultation	35,350	10,199	968	1,022	1,193	245	6	NA	48,983
	Total	2,387,399	1,269,457	406,643	292,373	108,021	43,542	4,778	277,740	4,789,953
	Percent in Total	49.8%	26.5%	8.5%	6.1%	2.3%	0.9%	0.1%	5.8%	100.0%
2008	Construction Projects	2,890,266	1,974,905	329,932	299,547	58,825	106,830	863	NA	5,661,168
	Labor Services	332,889	24,435	51,888	3,790	5,327	2,141	73	385,148	805,691
	Design Consultation	28,716	10,555	2,796	1,415	407	842	40	NA	44,771
	Total	3,251,025	2,009,895	384,616	304,752	64,559	109,813	976	385,148	6,511,630
	Percent in Total	49.9%	30.9%	5.9%	4.7%	1.0%	1.7%	0.0%	5.9%	100.0%

Note: Adapted from the China Statistical Yearbooks 2003 through 2009

Figure 5.2.17 shows the turnover fulfilled by Chinese contractors in the Asian market from 2002 to 2008. The total turnover grew more than 4 times from 7.8 billion USD in 2001 to 32.5 billion USD in 2008. As the major portion (82.6%) in total turnover, construction projects had a similar fast growth trend as the total turnover during this period. Meanwhile, the turnover of labor services maintained stability by an average increase rate of 8.6% each year. As for the design consultation, its turnover rose from 35.5 million USD in 2003 and peaked at 353.5 million USD (10 times) in 2007, followed by a drop by 18.8% in 2008. In short, all trends of turnovers in Asia were upward in this period.

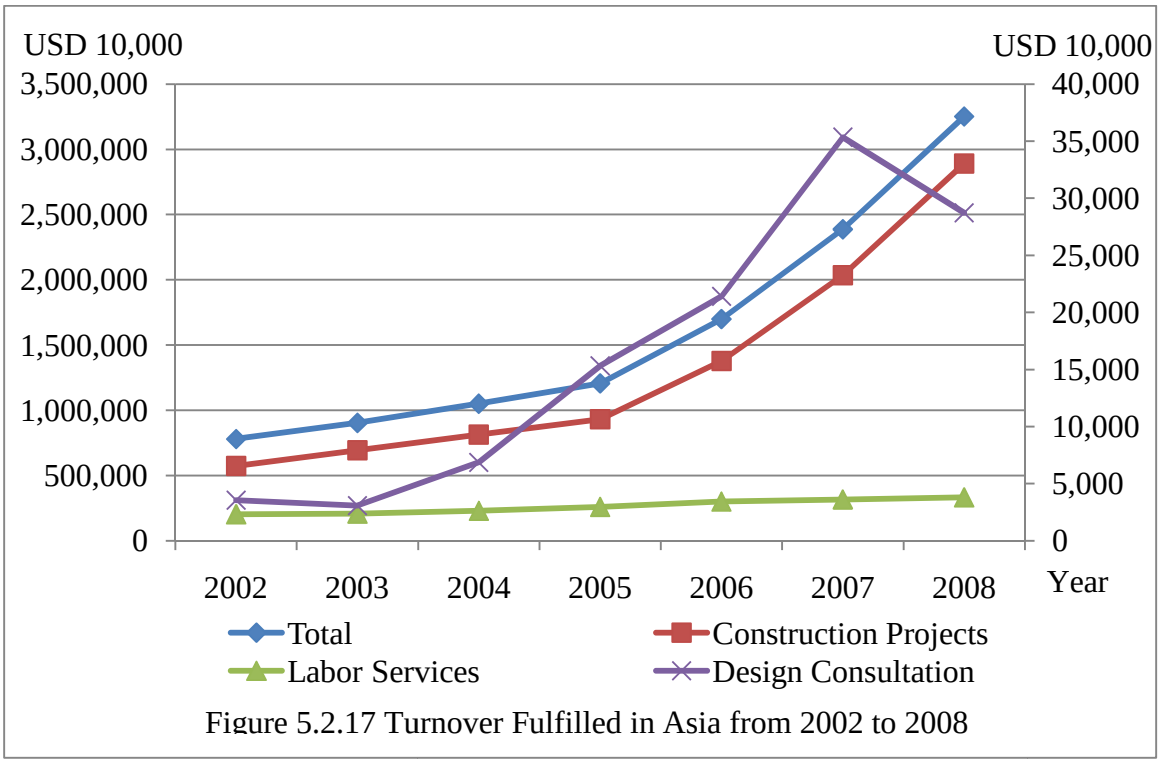

Figure 5.2.17 Turnover Fulfilled in Asia from 2002 to 2008

Note: Right scale shows Design Consultation; Left scale shows others.

During this period, the turnover of labor services in Africa fluctuated between 150 and 250 million USD as illustrated in Figure 5.2.18. The turnover of design consultation increased from 8.88 million USD in 2003 all the way to105.6 million USD in 2008 with the average

growth rate of 64% per year. As for the construction projects, its curve nearly overlapped with that of the total turnover, which indicated that construction projects accounted for a very high proportion (97%) in the Africa market. Based on the data analysis above, the average annual turnover per contract for construction projects was the largest in this period compared with labor services and design consultation.

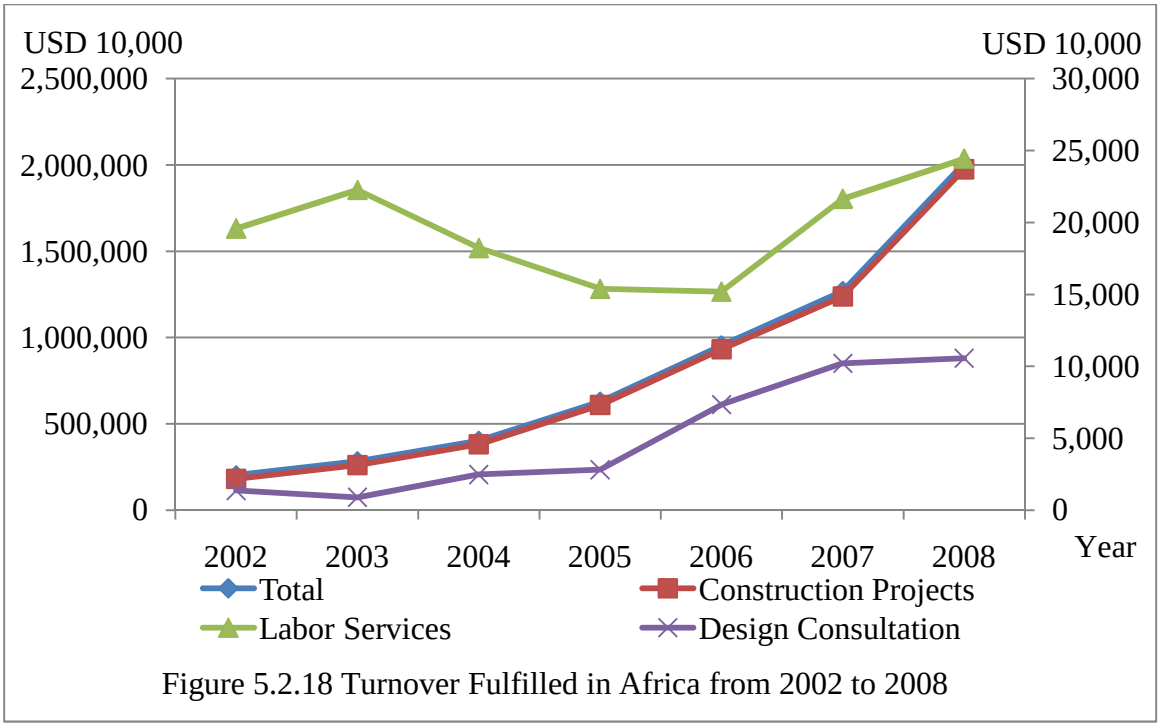

Figure 5.2.18 Turnover Fulfilled in Africa from 2002 to 2008

Note: Right scale shows Design Consultation and Labor Services; Left scale shows others.

In Europe, the turnover of construction projects increased constantly from 2002 to 2007 with the average growth rate of 31.6% per year as presented in Figure 5.2.19. In 2008, it dropped slightly to 3.85 billion USD. Labor services had an upward trend throughout the whole period with the average growth rate of 19.5% per year. In 2008, it surpassed 500 million USD. Compared with construction projects and labor services, the turnover of design consultation fluctuated dramatically from 2002 to 2008. As the smallest portion (0.5%) of total turnover, its average value was only 13.8 million USD per year in this period.

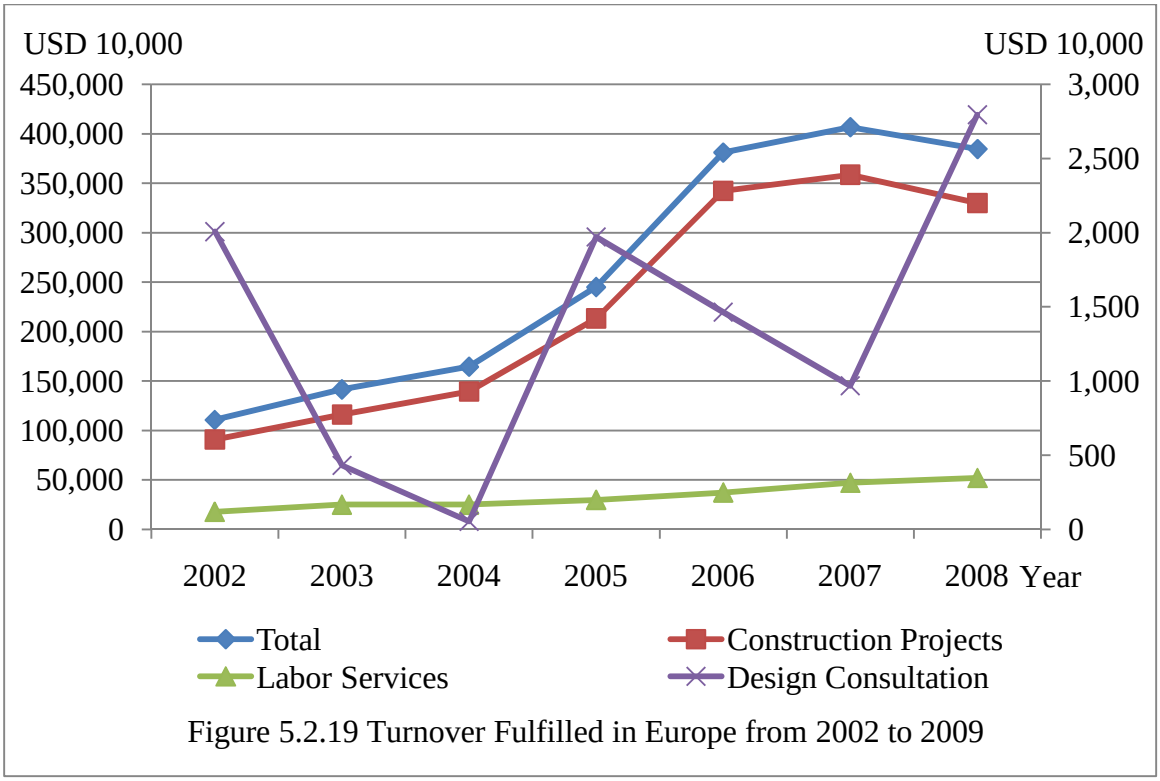

Figure 5.2.19 Turnover Fulfilled in Europe from 2002 to 2009

Note: Right scale shows Design Consultation; Left scale shows others.

Similar to Africa, in the Latin America market, the curve of construction projects also nearly overlapped with that of total turnover, and their growth trends were the same as shown in Figure 5.2.20. This was because construction projects accounted for as high as 96.5% proportion of the total turnover during this period. At the same time, labor services declined gradually at an average rate of 8% per year. As for design consultation, although it accounted only 0.3% of total turnover on average, its turnover rose dramatically and constantly from 2005 at an average growth rate of 156% per year.

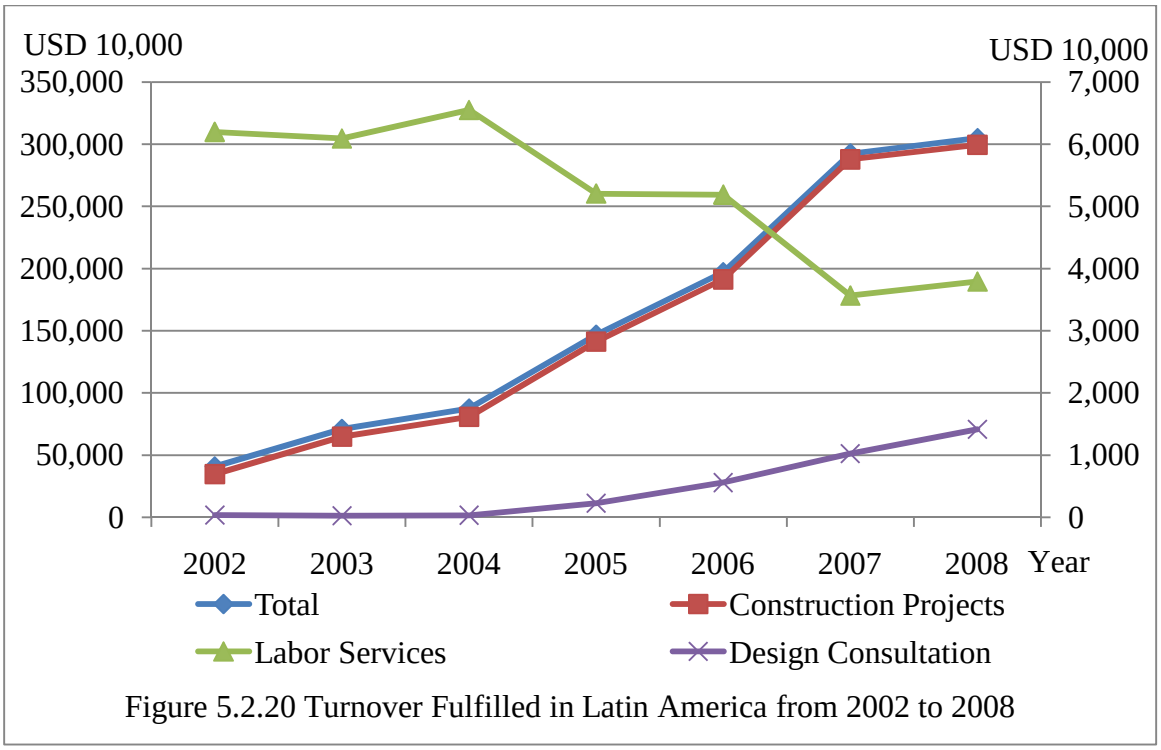

Figure 5.2.20 Turnover Fulfilled in Latin America from 2002 to 2008

Note: Right scale shows Design Consultation and Labor Services; Left scale shows others.

As illustrated in Figure 5.2.21, the turnovers of construction projects and design consultation fluctuated in North America. In 2008, their turnovers were 588 million USD and 4 million USD, respectively, which were close to the turnovers in 2002. But the turnover of labor services dropped by 63% over this period.

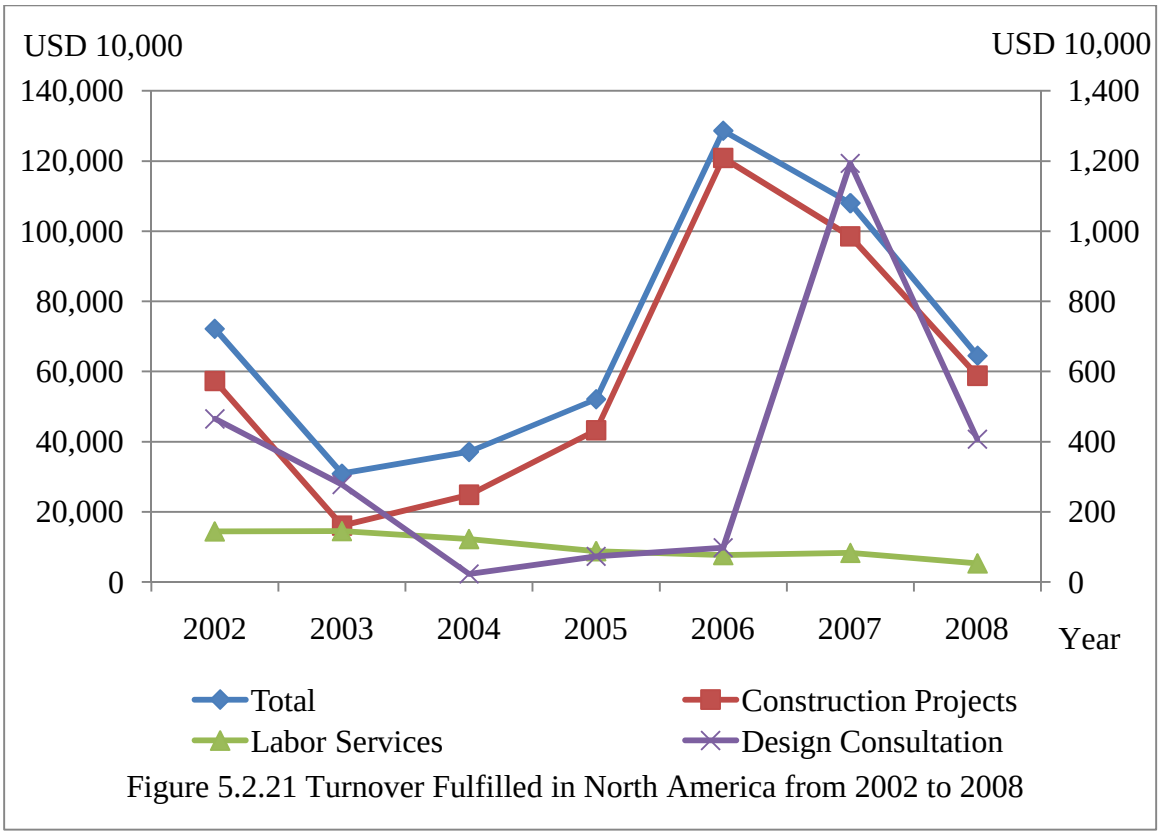

Figure 5.2.21 Turnover Fulfilled in North America from 2002 to 2008

Note: Right scale shows Design Consultation; Left scale shows others.

In Oceanic & Pacific Islands, the turnovers of construction projects and design consultation grew by 10.7 times and 18.6 times over this period, and especially in 2008 their growth rates were 155% and 244%, respectively. However, the turnover of labor services decreased by 30% from 2002 to 2008 as shown in Figure 5.2.22.

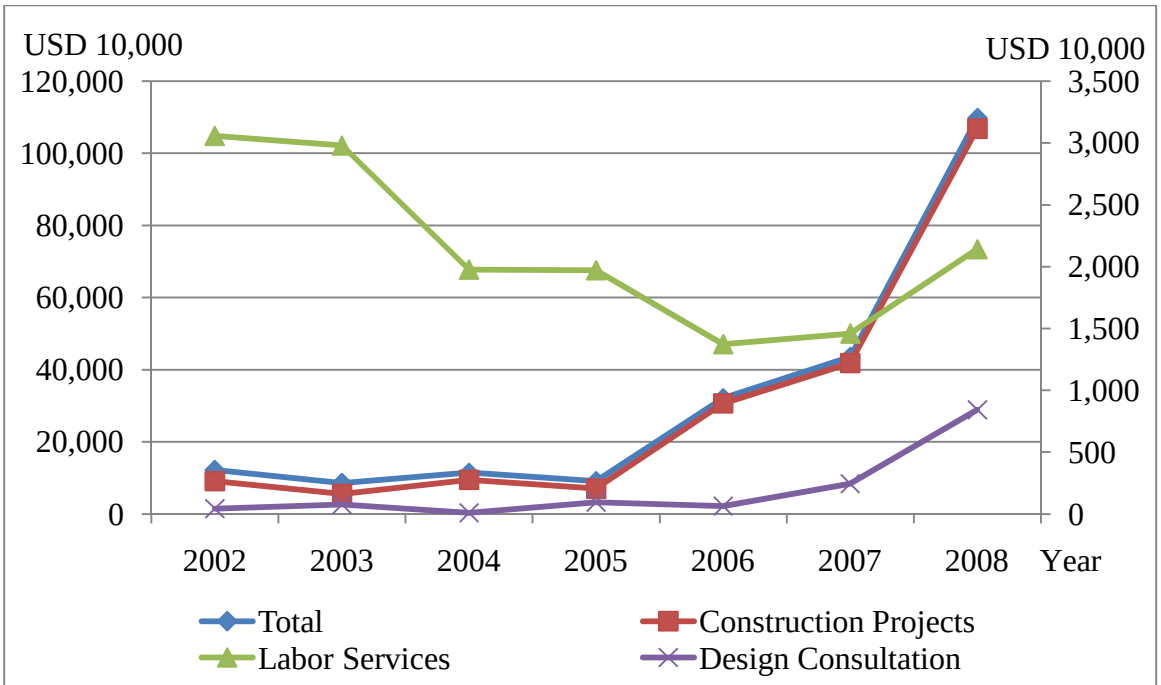

Figure 5.2.22 Turnover Fulfilled in Oceanic & Pacific Islands from 2002 to 2008

Note: Right scale shows Design Consultation and Labor Services; Left scale shows others.

Figure 5.2.23 presents the summary of turnovers in six regions. Except for North America, in the other five regions, the turnovers of the Chinese contractors increased by different degrees from 2002 to 2008. In current period, Asia and Africa were the two largest markets just as the previous period, and their growth rate increased each year from 15.8% and 36.2% in the beginning to 40.0% and 58.3% in the end, respectively. As for Europe and Latin America, their growth rates also increased at the beginning, but dropped in 2007 and 2008. North America was the only market where turnover declined by 10.6% during this period.

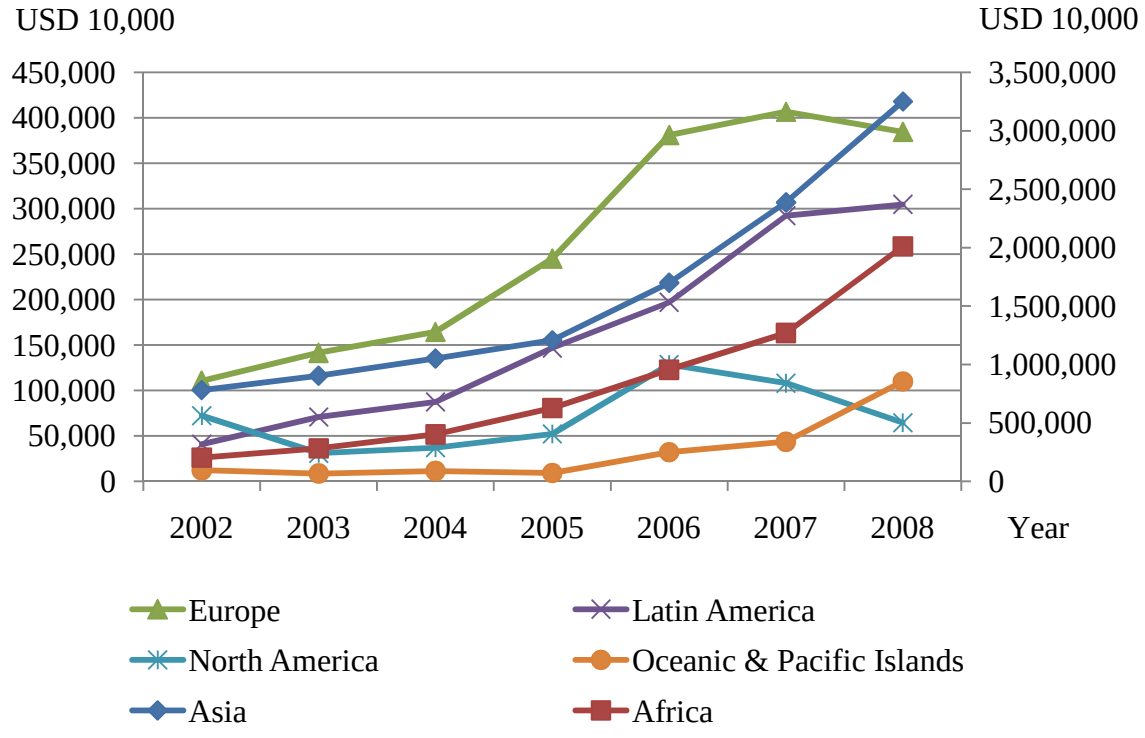

Figure 5.2.23 Turnover Fulfilled in Different Foreign Regions from 2002 to 2008

Note: Right scale shows Asia and Africa; Left scale shows others.

Figure 5.2.24 shows the summary of percentages of turnovers in six regions. The Asian market was also the largest market for Chinese contractors by percentage. Although its proportion dropped by 4.6% from 2002 to 2008, its average percent was still about 50%, which was more than twice that of Africa, the second largest. As for the second largest market, Africa's percentage increased most in this period from 14.1% to 30.9%, at an average growth rate of 14% per year. Besides, in the market of Latin America and Oceanic & Pacific Islands, the percentages of turnovers also rose during this period by 8.4% and 11.2%, respectively. However, in the market of Europe and North America, the percentages of turnovers declined, mainly due to two consecutive sharp drops in 2007 and 2008.

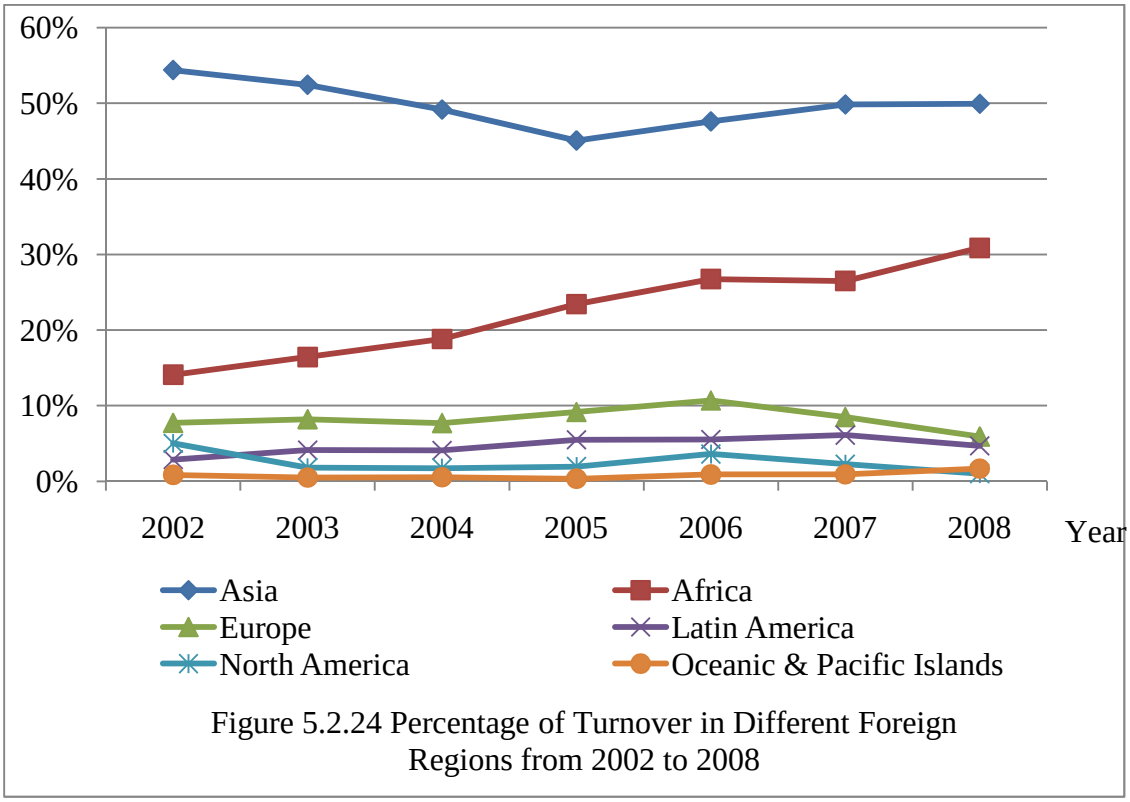

Figure 5.2.24 Percentage of Turnover in Different Foreign Regions from 2002 to 2008

5.2.3 Top Chinese Contractors in International Market

5.2.3.1 Global Picture

Table 5.2.6 shows a glance of the ENR Top 225 International Contractors (Top 225) from 2002 to 2008 in terms of their international revenue (IR), total revenue (TR), international new contract (INC), and total new contract (TNC).

Table 5.2.6 Revenue and New Contract of Top 225 from 2002 to 2008

Year	Revenue					New Contract				
	International			Total		International			Total	
	Value (billion USD□	Growth Rate	Percentage in Total	Value (billion USD)	Growth Rate	Value (billion USD)	Growth Rate	Percentage in Total	Value (billion USD)	Growth Rate
2002	116.5	9.4%	31.3%	372.7	5.1%	117.7	1.5%	32.5%	362.6	-0.3%
2003	139.8	20.0%	32.1%	435.1	16.7%	135.6	15.2%	30.3%	447.1	23.3%
2004	167.5	19.8%	33.3%	502.3	15.5%	166.4	22.8%	32.6%	510.3	14.1%
2005	189.4	13.1%	33.6%	562.8	12.1%	219.9	32.2%	35.4%	621.8	21.9%
2006	224.4	18.5%	34.5%	651.2	15.7%	300.2	36.5%	39.6%	758.6	22.0%
2007	310.2	38.2%	37.5%	827.0	27.0%	420.0	39.9%	42.8%	981.8	29.4%
2008	390.0	25.7%	40.4%	964.9	16.7%	472.1	12.4%	41.5%	1,136.6	15.8%

Note: Adapted from ENR 2003 through 2009

As presented in Figure 5.2.25, the IR of Top 225 increased constantly from 116.5 billion USD in 2002 to 390 billion USD in 2008. The average growth rate of IR during these years was 22.3% with the highest growth rate of 38.2% occurring in the year of 2007. Similarly, the TR of Top 225 rose from 372.7 billion USD to 964.9 billion USD in the same period. The percentage of IR in TR grew gradually each year with an average rate of 34.7%. The average TR growth rate was 17.2% which was about 5 percent less than the average IR growth rate.

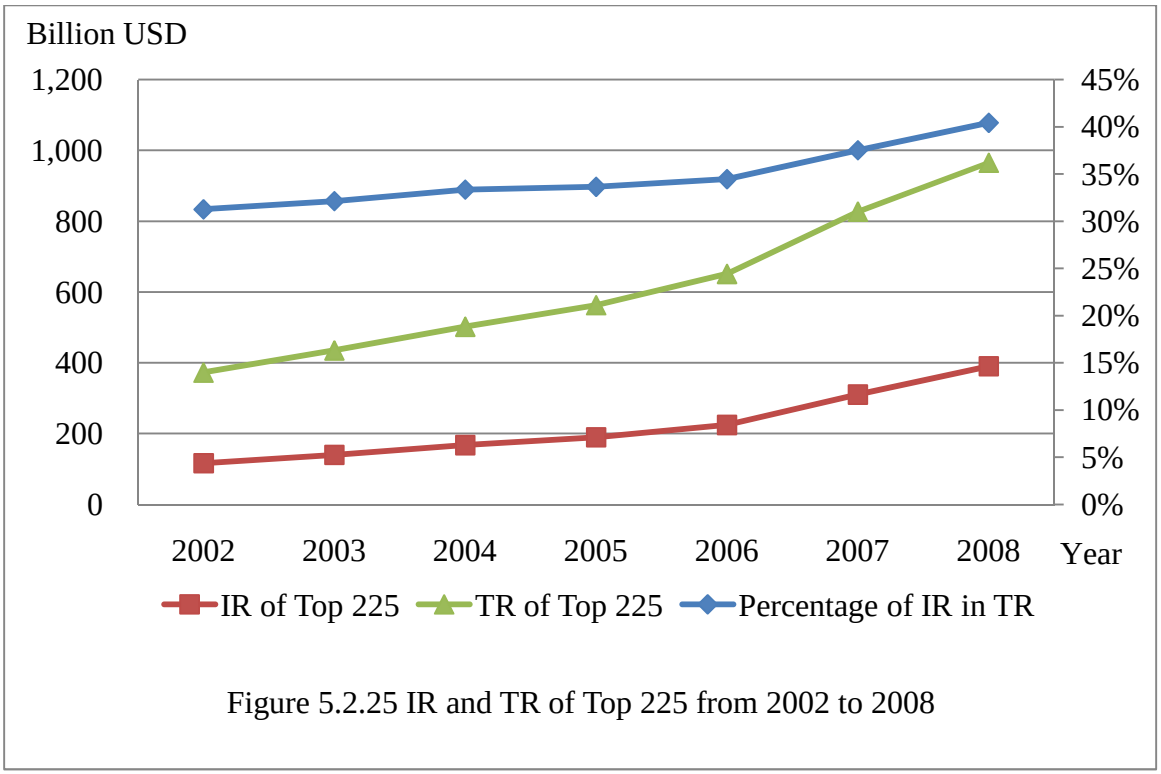

Figure 5.2.25 IR and TR of Top 225 from 2002 to 2008

Note: Left scale shows value; Right scale shows percentage.

Figure 5.2.26 shows that the INC of Top 225 rose from 117.7 billion USD in 2002 to 472.1 billion USD in 2008 at an average growth rate of 26%, while their TNC increased from 362.6 billion USD to 1136.6 billion USD in the same period at an average growth rate of 21%. The average percentage of INC in TNC was 36.4%. Compared with the revenue, the new contracting values were usually higher because new contracts include the contractual values of all new contracts awarded during the year, even if no work was performed to execute the contract in the measured year; while only the actual work of the contract that was paid in the measured year could be claimed in the revenue category. With the advent of huge, multi-year contract awards for such projects as the environmental cleanup at the U.S. nuclear facility in Hanford, Wash., new contracting value could fluctuate wildly from year to year leaving a

skewed view of the markets and individual companies. Thus, the data analysis hereafter will mainly be based on revenue value.

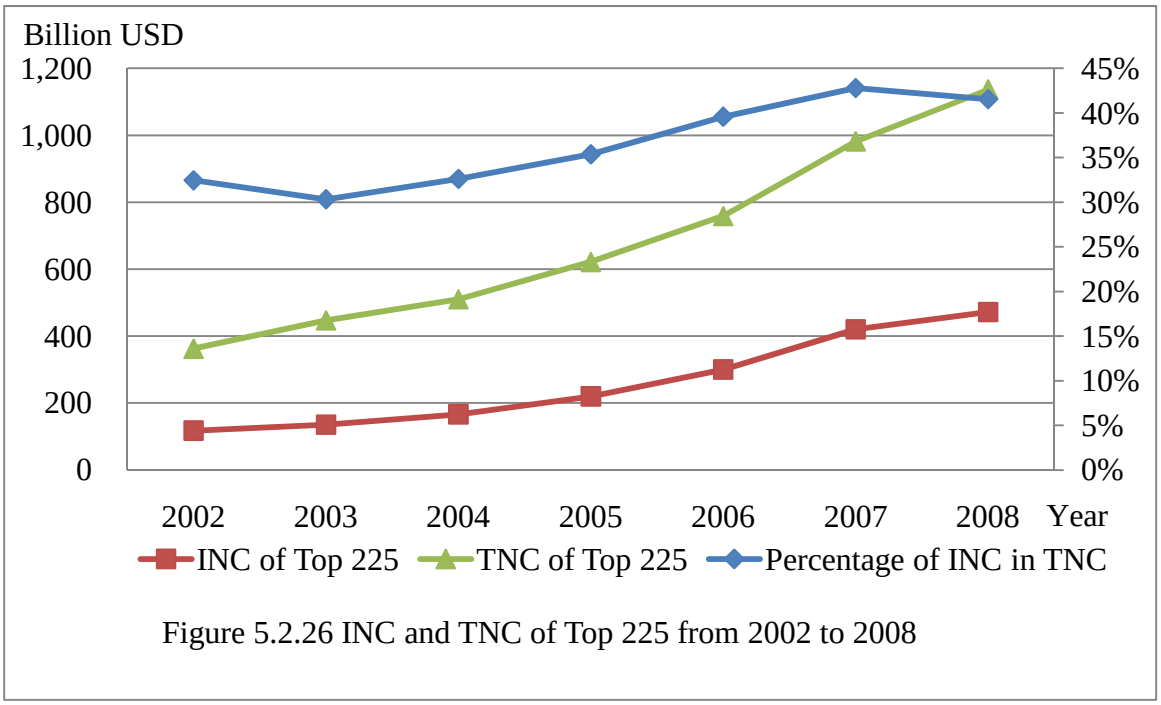

Figure 5.2.26 INC and TNC of Top 225 from 2002 to 2008

Note: Left scale shows value; Right scale shows percentage.

Table 5.2.7 shows the revenue fulfilled by Top 225 in the following 11 categories including: building, manufacturing, industrial, petroleum, water, sewer/waste, transportation, hazardous waste, power, telecommunication, and other. Their respective percentages in total revenues are also presented.

Table 5.2.7 IR of Top 225 in Different Project Categories

Year		2002	2003	2004	2005	2006	2007	2008
Building	Value (million USD)	33,385.9	35,527.5	41,565.7	52,629.4	59,431.9	73,955.0	94,067.6
	Percentage in Total	28.7%	25.4%	24.8%	27.8%	26.5%	23.8%	24.1%
Manufacturing	Value (million USD)	3,349.3	3,455.1	5,028.3	4,857.1	7,516.0	7,081.3	6,916.9
	Percentage in Total	2.9%	2.5%	3.0%	2.6%	3.3%	2.3%	1.8%
Industrial	Value (million USD)	6,618.1	8,680.6	8,902.9	10,159.5	11,780.8	15,330.5	23,001.3
	Percentage in Total	5.7%	6.2%	5.3%	5.4%	5.2%	4.9%	5.9%
Petroleum	Value (million USD)	24,009.2	26,107.7	30,679.2	33,497.0	45,084.3	80,039.9	90,837.8
	Percentage in Total	20.6%	18.7%	18.3%	17.7%	20.1%	25.8%	23.3%
Water	Value (million USD)	3,500.9	3,865.0	4,188.4	4,382.8	5,803.3	8,637.6	14,234.2
	Percentage in Total	3.0%	2.8%	2.5%	2.3%	2.6%	2.8%	3.6%
Sewer/waste	Value (million USD)	1,712.2	2,091.8	3,400.2	3,394.5	2,849.1	4,818.7	5,813.9
	Percentage in Total	1.5%	1.5%	2.0%	1.8%	1.3%	1.6%	1.5%
Transportation	Value (million USD)	28,727.5	38,444.7	44,042.9	50,875.8	58,927.8	79,377.7	104,092.2
	Percentage in Total	24.7%	27.5%	26.3%	26.9%	26.3%	25.6%	26.7%
Hazardous waste	Value (million USD)	288.7	293.8	668.3	537.2	606.3	605.0	549.2
	Percentage in Total	0.2%	0.2%	0.4%	0.3%	0.3%	0.2%	0.1%
Power	Value (million USD)	8,015.0	9,458.8	10,130.2	11,741.6	14,441.2	17,180.6	26,723.5
	Percentage in Total	6.9%	6.8%	6.0%	6.2%	6.4%	5.5%	6.9%
Telecommunication	Value (million USD)	1,858.0	2,020.9	1,951.6	2,255.0	2,900.2	3,323.4	3,937.3
	Percentage in Total	1.6%	1.4%	1.2%	1.2%	1.3%	1.1%	1.0%
Other	Value (million USD)	5,051.7	9,877.1	16,928.8	15,082.4	15,086.9	19,897.3	19,833.7
	Percentage in Total	4.3%	7.1%	10.1%	8.0%	6.7%	6.4%	5.1%

Note: Adapted from ENR 2003 through 2009

According to Figure 5.2.27, building, petroleum and transportation were the largest business sectors based on revenue in Top 225. Their average growth rates were 19%, 25% and

24%, respectively. In 2008, transportation became the largest sector with the revenue of 104.1 billion USD. As for the other 8 categories, only industrial and power sectors exceeded the mark of 20 billion USD in 2008.

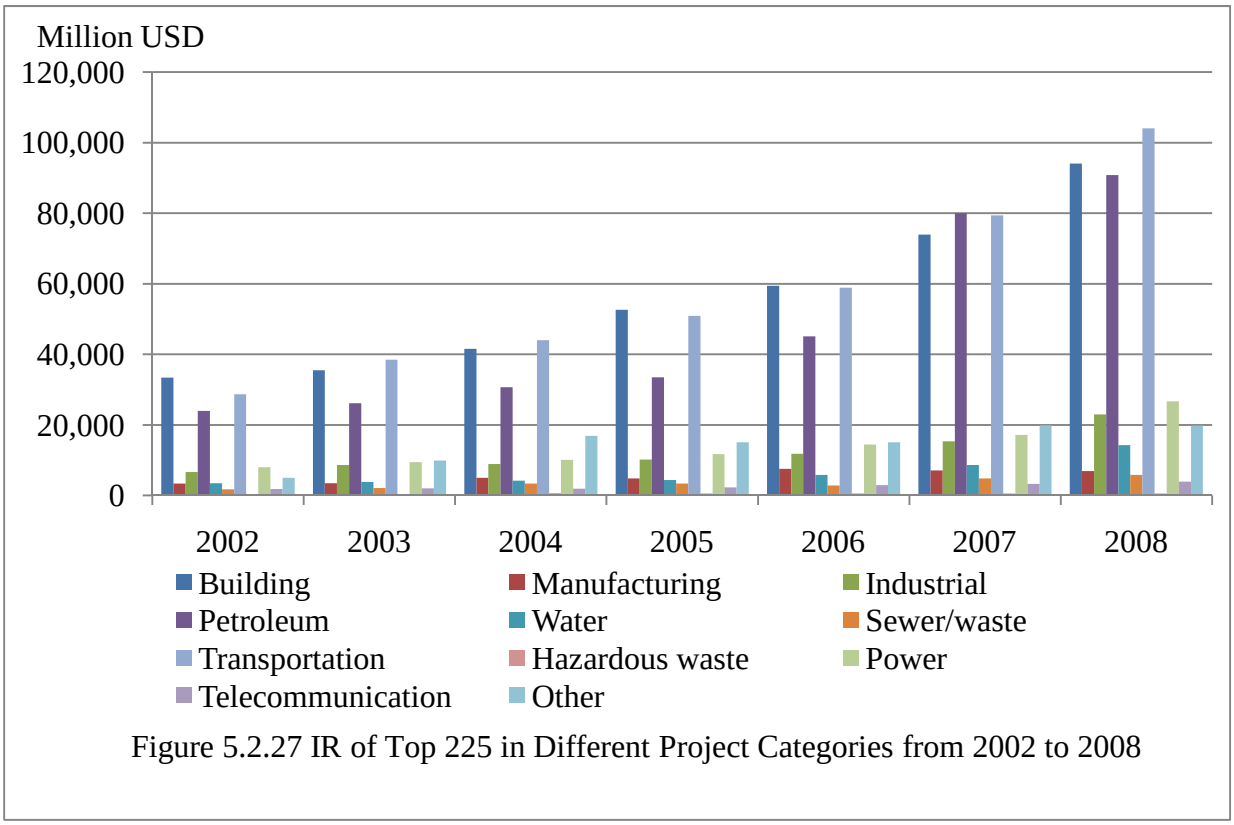

Figure 5.2.27 IR of Top 225 in Different Project Categories from 2002 to 2008

Similarly, based on the percentage of revenue, building, petroleum and transportation were the largest sectors, and their combined percentage was between 69% and 76% during this period. The percentage of each of other 8 types was less than 10% from 2002 to 2008, except for the percentage of power sector, it reached 10.1% in 2004 as shown in Figure 5.2.28.

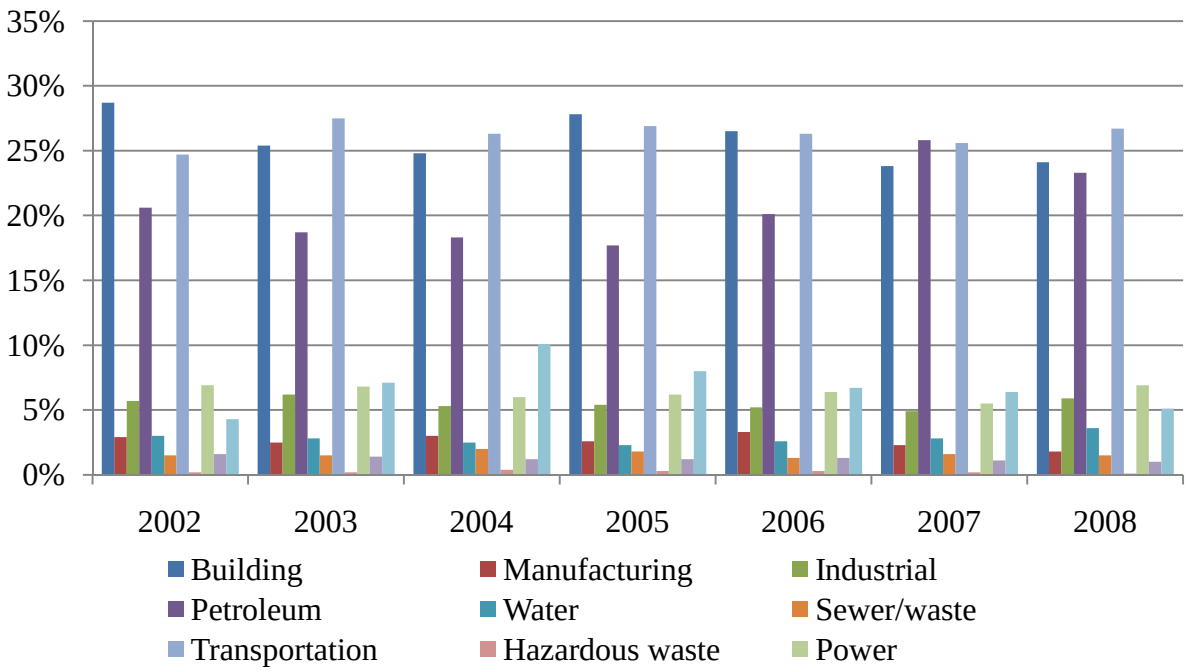

Figure 5.2.28 Percentage of IR of Top 225 in Different Project Categories from 2002 to 2008

Table 5.2.8 presents the summary of IR fulfilled by Top 225 in different regions along with the respective percentage in total, the number of firms in each region, and the average revenue per firm.

Table 5.2.8 IR of Top 225 in Different Regions

Year	Value (million USD)	Percentage in Total	No. of Firms	Average Revenue per Firm (million USD)	Year	Value (million USD)	Percentage in Total	No. of Firms	Average Revenue per Firm (million USD)
Middle East					Asia/Australia				
2002	9,743.6	8.4%	95	102.6	2002	22,684.1	19.5%	131	173.2
2003	16,455.6	11.8%	101	162.9	2003	26,029.5	18.6%	135	192.8
2004	25,415.4	15.2%	123	206.6	2004	30,465.3	18.2%	146	208.7
2005	28,155.4	14.9%	120	234.6	2005	33,781.3	17.8%	157	215.2
2006	41,380.8	18.4%	130	318.3	2006	40,185.2	17.9%	149	269.7
2007	62,894.9	20.3%	141	446.1	2007	55,399.5	17.9%	155	357.4
2008	77,470.6	19.9%	155	499.8	2008	68,532.5	17.6%	160	428.3
South/Central Africa					North Africa				
2002	5,937.5	5.1%	79	75.2	2002	5,200.5	4.5%	83	62.7
2003	7,138.2	5.1%	89	80.2	2003	5,517.2	3.9%	81	68.1
2004	7,221.9	4.3%	90	80.2	2004	7,061.9	4.2%	93	75.9
2005	9,226.6	4.9%	85	108.5	2005	5,912.5	3.1%	91	65.0
2006	10,395.4	5.6%	87	119.5	2006	7,515.8	3.3%	93	80.8
2007	15,420.8	5.0%	82	188.1	2007	13,174.6	4.2%	114	115.6
2008	29,262.2	7.5%	95	308.0	2008	21,622.9	5.5%	123	175.8
USA					Canada				
2002	23,113.3	19.8%	45	513.6	2002	4,464.6	3.8%	53	84.2
2003	22,778.8	16.3%	48	474.6	2003	4,756.1	3.4%	42	113.2
2004	22,795.4	13.6%	52	438.4	2004	4,962.6	3.0%	37	134.1
2005	24,974.2	13.2%	56	446.0	2005	6,307.3	3.3%	40	157.7
2006	29,130.1	13.0%	54	539.4	2006	7,990.7	3.6%	42	190.3
2007	36,906.1	11.9%	63	585.8	2007	8,281.3	2.7%	44	188.2
2008	41,759.5	10.7%	60	696.0	2008	13,402.0	3.4%	43	311.7
Latin America					Caribbean Islands				
2002	8,123.0	7.0%	89	91.3	2002	1,428.3	1.2%	53	26.9
2003	7,630.1	5.5%	81	94.2	2003	2,251.1	1.6%	49	45.9
2004	7,399.0	4.4%	80	92.5	2004	1,654.6	1.0%	40	41.4
2005	10,662.8	5.6%	80	133.3	2005	1,414.5	0.7%	41	34.5
2006	13,622.8	6.1%	86	158.4	2006	2,247.1	1.0%	43	52.3
2007	19,249.6	6.2%	92	209.2	2007	2,007.2	0.6%	38	52.8
2008	21,761.9	5.6%	85	256.0	2008	2,077.8	0.5%	39	53.3
Europe					Unallocated/Other				
2002	33,091.5	28.4%	115	287.8	2002	2,730.1	2.3%	NA	NA
2003	46,659.3	33.4%	112	416.6	2003	607.1	0.4%	3	202.4
2004	60,265.9	36.2%	114	528.6	2004	244.6	0.1%	5	48.9
2005	68,584.0	36.2%	124	553.1	2005	393.7	0.2%	2	196.9
2006	71,858.2	32.0%	119	603.9	2006	101.6	0.0%	5	20.3
2007	96,448.8	31.1%	136	709.2	2007	464.0	0.1%	4	116.0
2008	114,106.2	29.3%	140	815.0	2008	12.3	0.0%	3	4.1

Note: Adapted from ENR 2003 through 2009

5.2.3.2 Chinese Contractors in Top 225

Table 5.2.9 shows a glance of the Top CC from 2002 to 2008 in terms of their number, IR, growth rate of IR per year, percentage of IR in Top 225, and average IR per firm.

Table 5.2.9 Number and IR of Top CC

Year	2002	2003	2004	2005	2006	2007	2008
Number of Top CC	43	47	49	46	49	51	50
IR (million USD)	7,128.9	8,332.9	8,829.1	10,067.9	16,289.4	22,677.6	43,202.5
Growth Rate	NA	16.9%	6.0%	14.0%	61.8%	39.2%	90.5%
IR Percentage in Top 225	6.1%	6.0%	5.3%	5.3%	7.3%	7.3%	11.1%
Average IR per Top CC (million USD)	165.8	177.3	180.2	218.9	332.4	444.7	864.1

Note: Adapted from ENR 2003 through 2009

(The data of percentage were calculated based on the above Table 5.2.8)

Table 5.2.10 presents the summary of IR fulfilled by Top CC in different regions along with the respective percentage in Top 225.

Table 5.2.10 IR of Top CC in Different Regions

Year		2002	2003	2004	2005	2006	2007	2008
Middle East	IR (million USD)	731.7	963.0	1,034.1	1,329.6	1,980.1	3,482.2	5,048.4
	Percentage in Top 225	7.5%	5.9%	4.1%	4.7%	4.8%	5.5%	6.5%
Asia/ Australia	IR (million USD)	4,148.1	5,373.6	5,512.8	5,070.8	7,563.4	9,177.0	13,723.9
	Percentage in Top 225	18.2%	20.6%	16.8%	15.0%	18.8%	16.6%	20.0%
Africa	IR (million USD)	1,103.9	1,492.1	2,106.8	3,233.5	5,083.5	7,695.8	21,578.2
	Percentage in Top 225	9.9%	11.8%	14.7%	21.4%	28.4%	26.9%	42.4%
Europe	IR (million USD)	468.6	234.7	255.2	115.6	509.9	990.6	1,461.7
	Percentage in Top 225	1.4%	0.5%	0.4%	0.2%	0.7%	1.0%	1.3%
USA	IR (million USD)	174.6	91.2	174.4	58.5	311.4	389.4	323.4
	Percentage in Top 225	0.8%	0.4%	0.8%	0.2%	1.1%	1.1%	0.8%
Canada	IR (million USD)	5.7	0.5	NA	2.5	22.0	44.8	12.9
	Percentage in Top 225	0.1%	0.0%	NA	0.0%	0.3%	0.5%	0.1%
Latin America/ Caribbean Islands	IR (million USD)	496.5	177.8	145.8	257.5	783.0	897.9	1,046.4
	Percentage in Top 225	5.2%	1.8%	1.6%	2.1%	4.9%	4.2%	4.4%

Note: Adapted from ENR 2003 through 2009

(The data of percentage were calculated based on the above Table 5.2.8)

From 2002 to 2008, the IR of Top 225 rose from 116.5 to 390.0 billion USD at an average growth rate of 22.3% per year; while the IR of Top CC increased from 7.1 to 43.2 billion USD at an average growth rate of 35.1% per year, which was 12.8% more than that of Top 225 as shown in Figure 5.2.29.

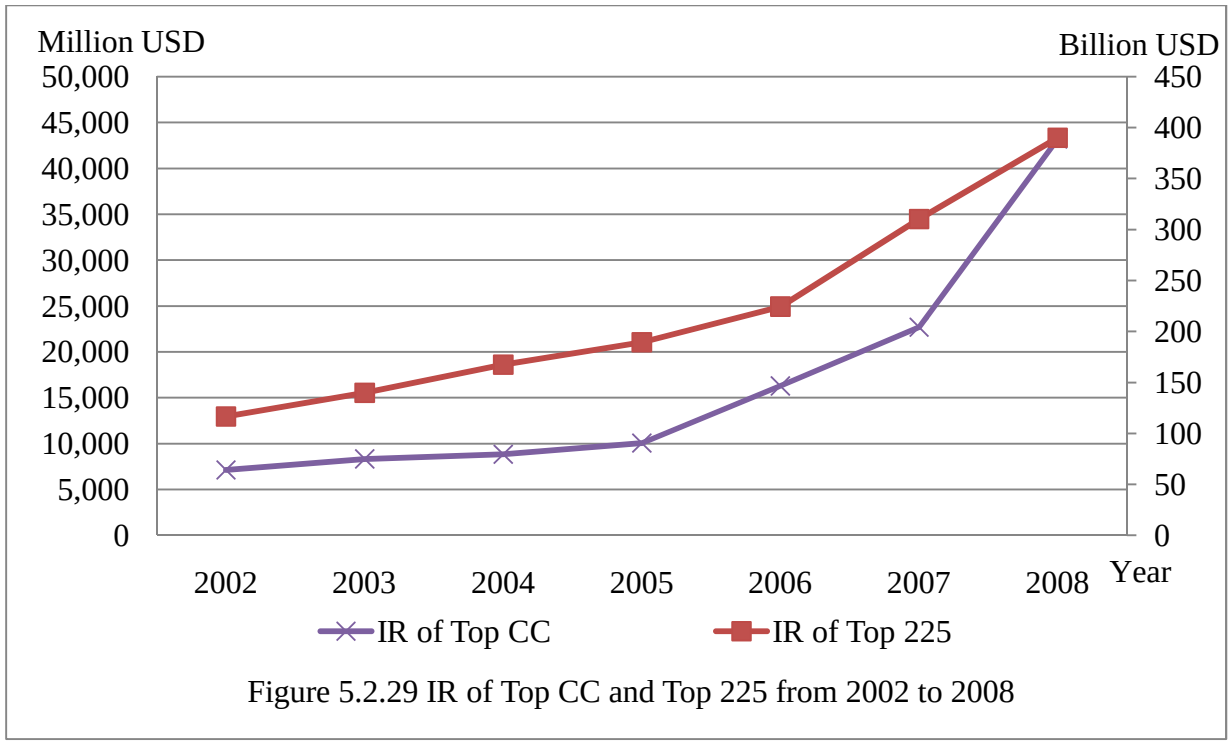

Figure 5.2.29 IR of Top CC and Top 225 from 2002 to 2008

Note: Left scale shows Top CC; Right scale shows Top 225.

The IR percentage of Top CC was about 6% of Top 225's IR from 2002 to 2007. However, it jumped to 11.1% in 2008 as shown in Figure 5.2.30.

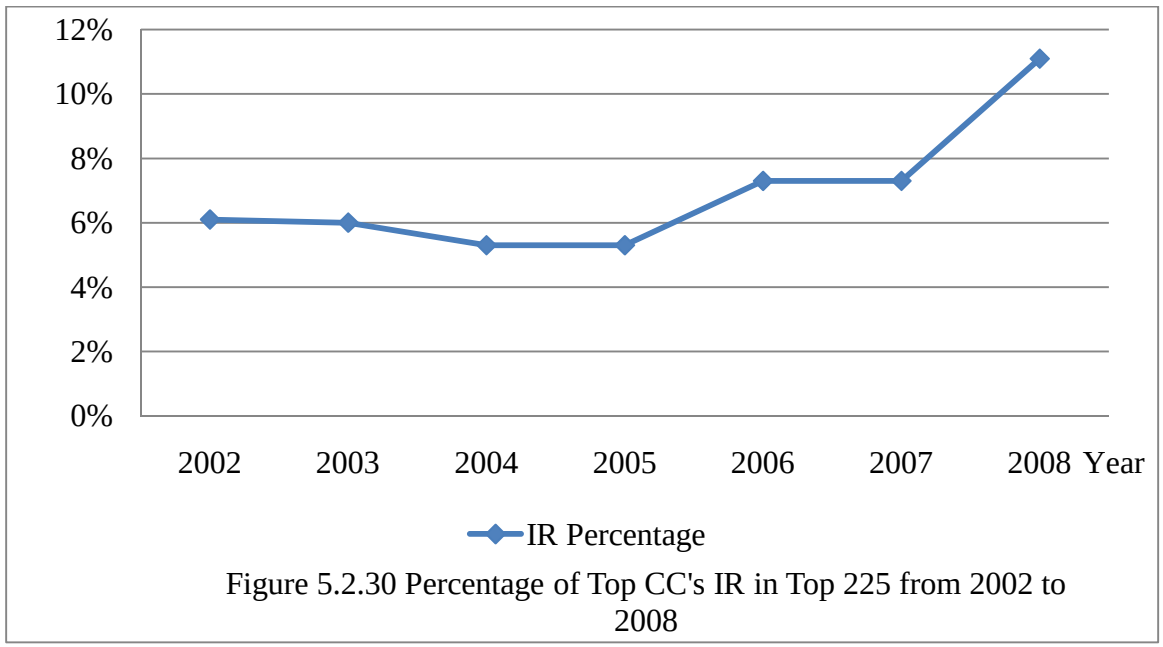

Figure 5.2.30 Percentage of Top CC's IR in Top 225 from 2002 to 2008

Compared with that of Top 225, the average IR per Top CC was much smaller. As presented in Figure 5.2.31, even in 2008 when it peaked at 864.1 million USD per contractor, the average IR per Top CC was only 50% of that of Top 225, while in other year this percentage was even lower, with the lowest at 24.2% in 2004. However, the average growth rate of Top CC was 31.7% each year, which was 9.4% more than that of Top 225.

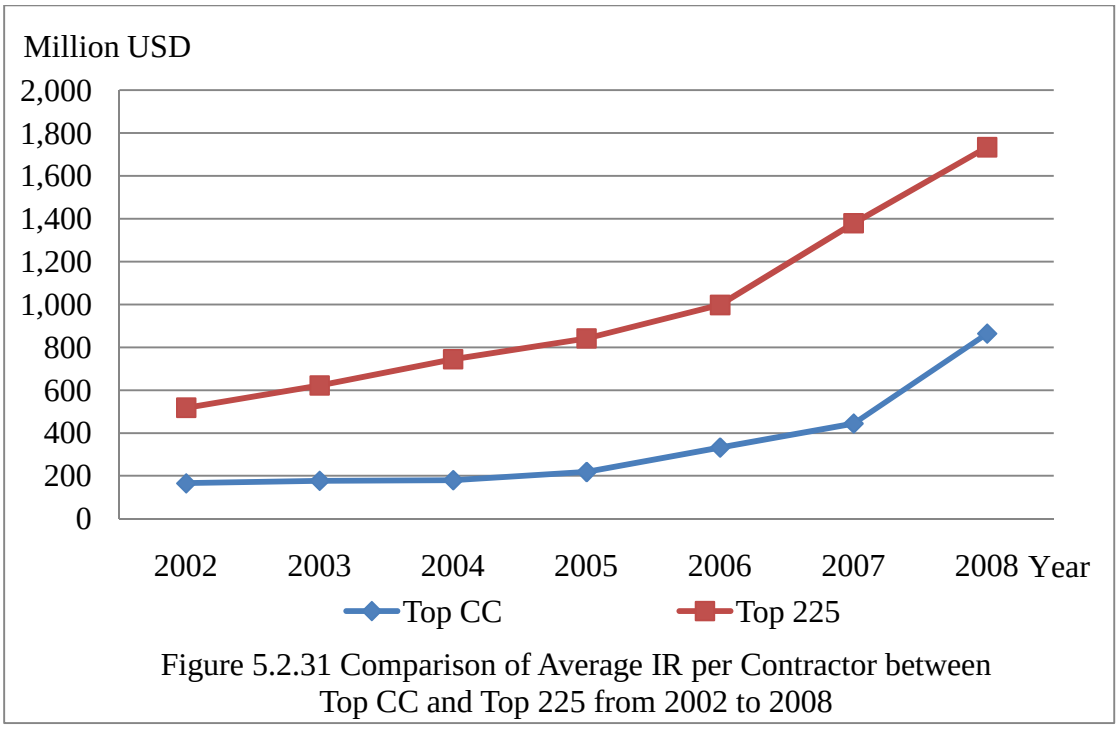

Figure 5.2.31 Comparison of Average IR per Contractor between Top CC and Top 225 from 2002 to 2008

In Middle East, the IR of Top CC increased from 731.7 to 5,048.4 million USD in this period at an average growth rate of 40% per year as shown in Figure 5.2.32. However, its percentage in overall IR fulfilled by Top 225 decreased from 7.5% to 6.5%; especially in 2004 it dropped to 4.1%. This indicated that in Middle East the growth rate of IR by Top 225 was even more than that of Top CC from 2002 to 2008. A cubic polynomial curve (with $R^2 = 0.9956$) can be developed to accurately match the growth trend of Top CC's IR in Middle East during this period. The polynomial function is:

$$y = 23.653x^3 - 110.74x^2 + 261.28x + 601.94 \quad (5.4)$$

where

x = year

y = Top CC's IR in Middle East in million USD.

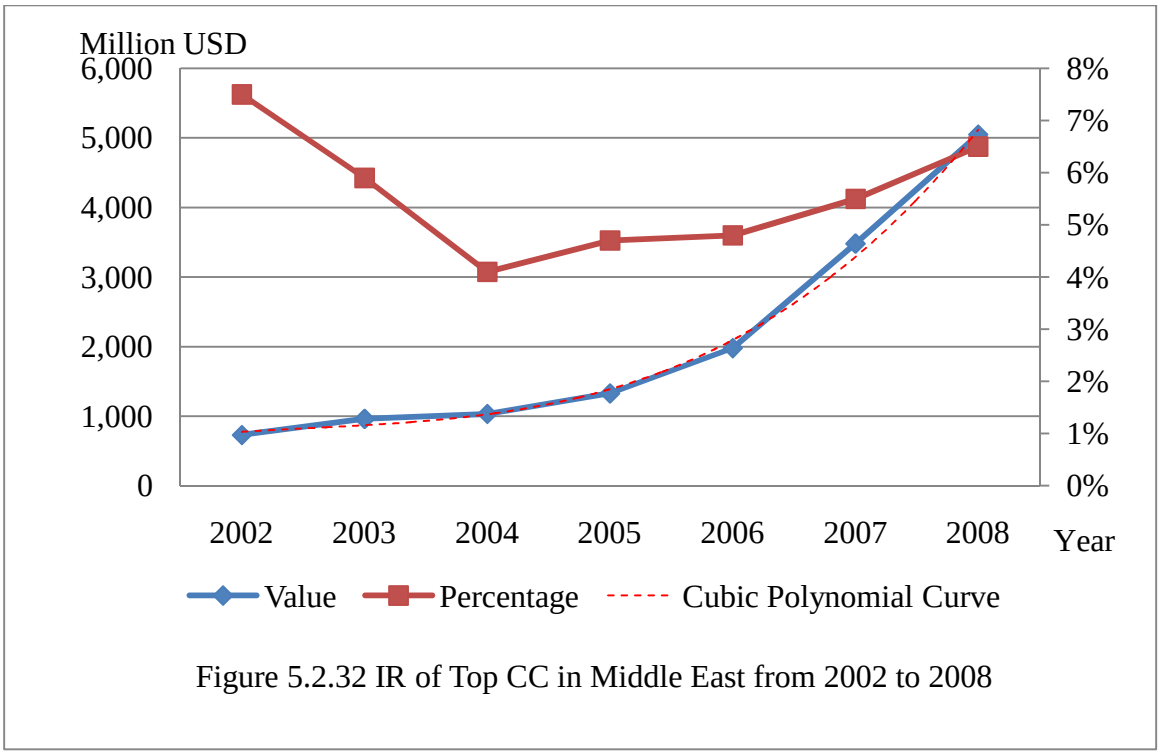

Figure 5.2.32 IR of Top CC in Middle East from 2002 to 2008

Note: Left scale shows value; Right scale shows percentage.

As presented in Figure 5.2.33, the IR of Top CC in Asia and Australia rose from 4.1 to 13.7 billion USD at an average growth rate of 22.3% per year. On the other hand, its percentage in Top 225 fluctuated slightly between 15.0% and 20.6% in the same period. This suggested that from 2002 to 2008, the development of Top CC in the Asian and Australian market was relatively stable. A cubic polynomial curve (with $R^2 = 0.9836$) can be developed to accurately

match the growth trend of Top CC's IR in Asia and Australia during this period. The polynomial function is:

$$y = 103.38x^3 - 885.26x^2 + 2766.9x + 2282.9 \quad (5.5)$$

where

x = year

y = Top CC's IR in Asia and Australia in million USD.

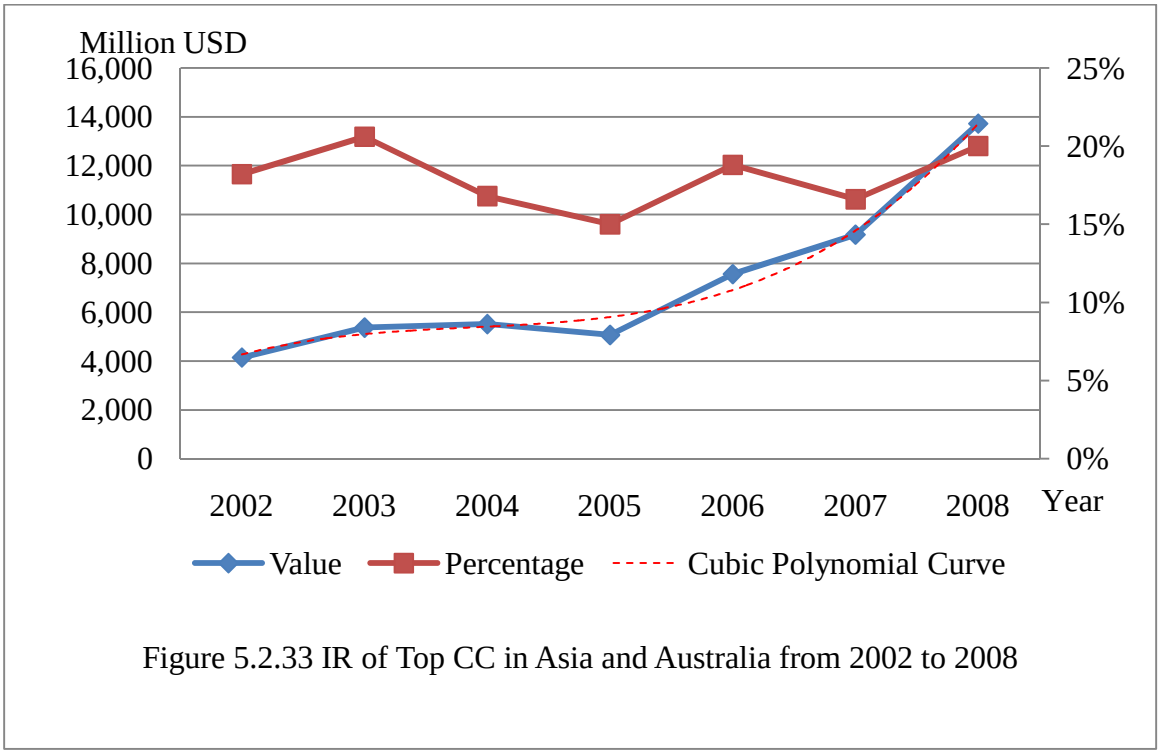

Figure 5.2.33 IR of Top CC in Asia and Australia from 2002 to 2008

Note: Left scale shows value; Right scale shows percentage.

According to Figure 5.2.34, the Top CC achieved significant progress in Africa. Their IR grew from 1.1 to 21.6 billion USD with an average increase rate of 64% in this period. Meanwhile, the Top CC's IR percentage in Top 225 rose from 9.9% in 2002 to 42.4% in 2008. Top CC replaced the European contractors (accounted for 35.7% in 2008) as the largest group of contractors in the African market in 2008. A cubic polynomial curve (with $R^2 = 0.9763$) can be

used to accurately match the growth trend of Top CC's IR in Africa during this period. The polynomial function is:

$y = 313.72x^3 - 2825.3x^2 + 8090.8x - 4952.1$ (5.6)

where

x = year

y = Top CC's IR in Africa in million USD.

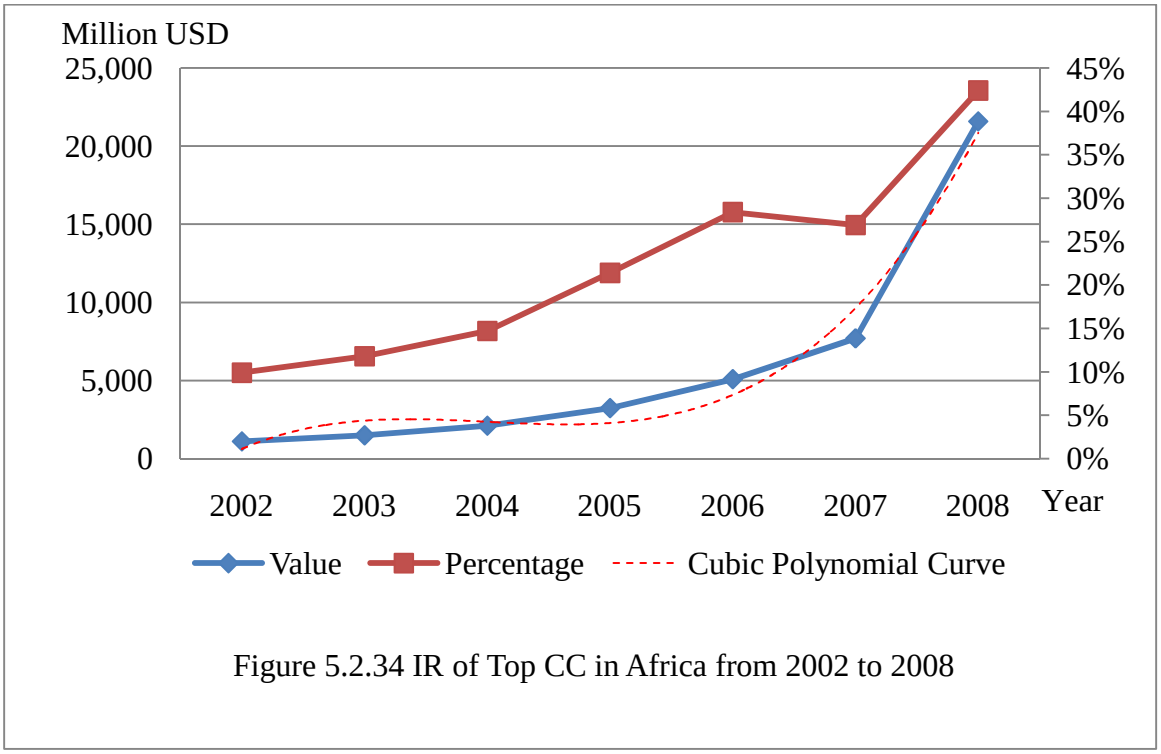

Figure 5.2.34 IR of Top CC in Africa from 2002 to 2008

Note: Left scale shows value; Right scale shows percentage.

In Latin America and Caribbean Islands, the IR of Top CC increased from 496.5 to 1,046.4 million USD at an average growth rate of 13.2% per year as shown in Figure 5.2.35. But Top CC's IR percentage in Top 225 declined from 5.2% to 4.4%; especially in the years of 2003 and 2004, its IR percentage was below 2%. This indicated that from 2002 to 2008, the growth

rate of IR fulfilled by Top CC in Latin America and Caribbean Islands was lower than that of Top 225.

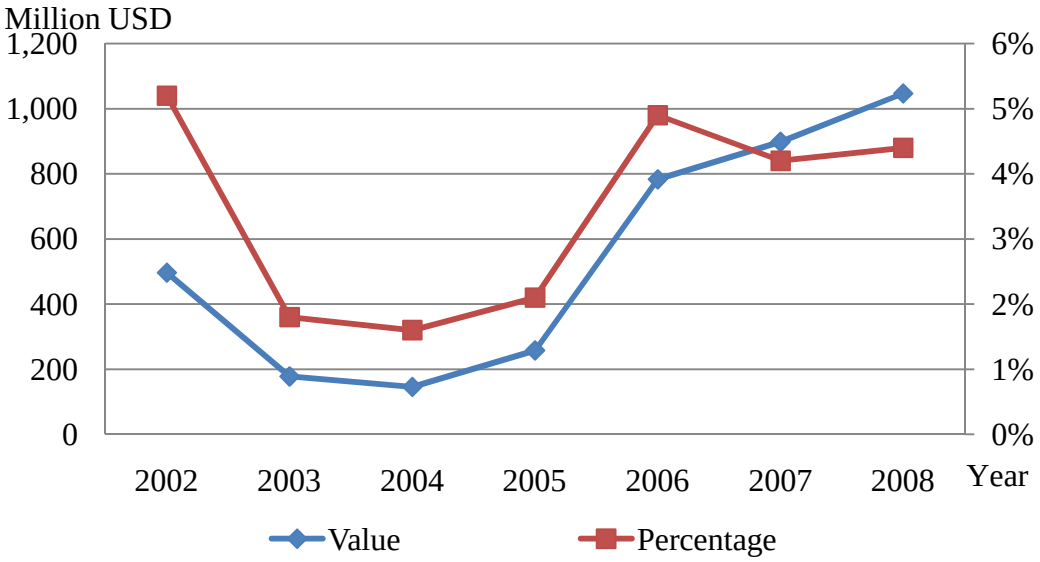

Figure 5.2.35 IR of Top CC in Latin America and Caribbean Islands from 2002 to 2008

Note: Left scale shows value; Right scale shows percentage.

Compared with the above discussed regions, the Top CC's IRs were relatively small in Europe, USA, and Canada. In terms of their respective percentages in Top 225, none of the three exceeded 1.5%. However, their IR values still had upward trend in this period as shown in Figures 5.2.36, 5.2.37 and 5.2.38.

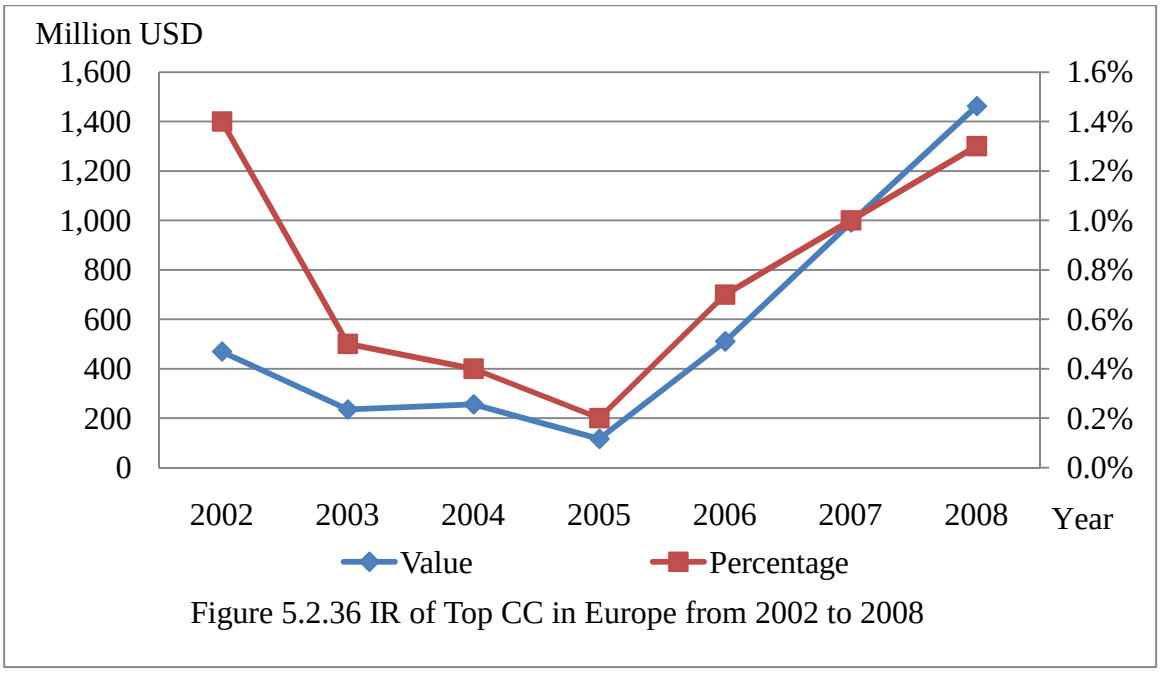

Figure 5.2.36 IR of Top CC in Europe from 2002 to 2008

Note: Left scale shows value; Right scale shows percentage.

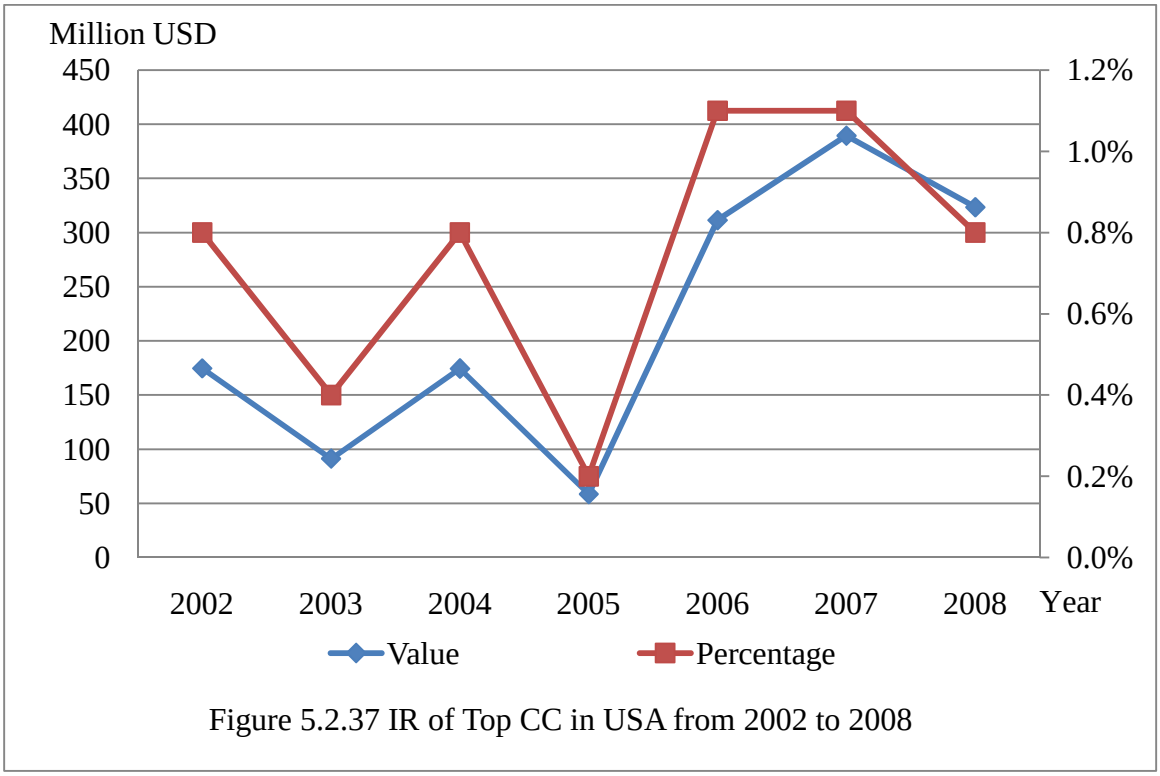

Figure 5.2.37 IR of Top CC in USA from 2002 to 2008

Note: Left scale shows value; Right scale shows percentage.

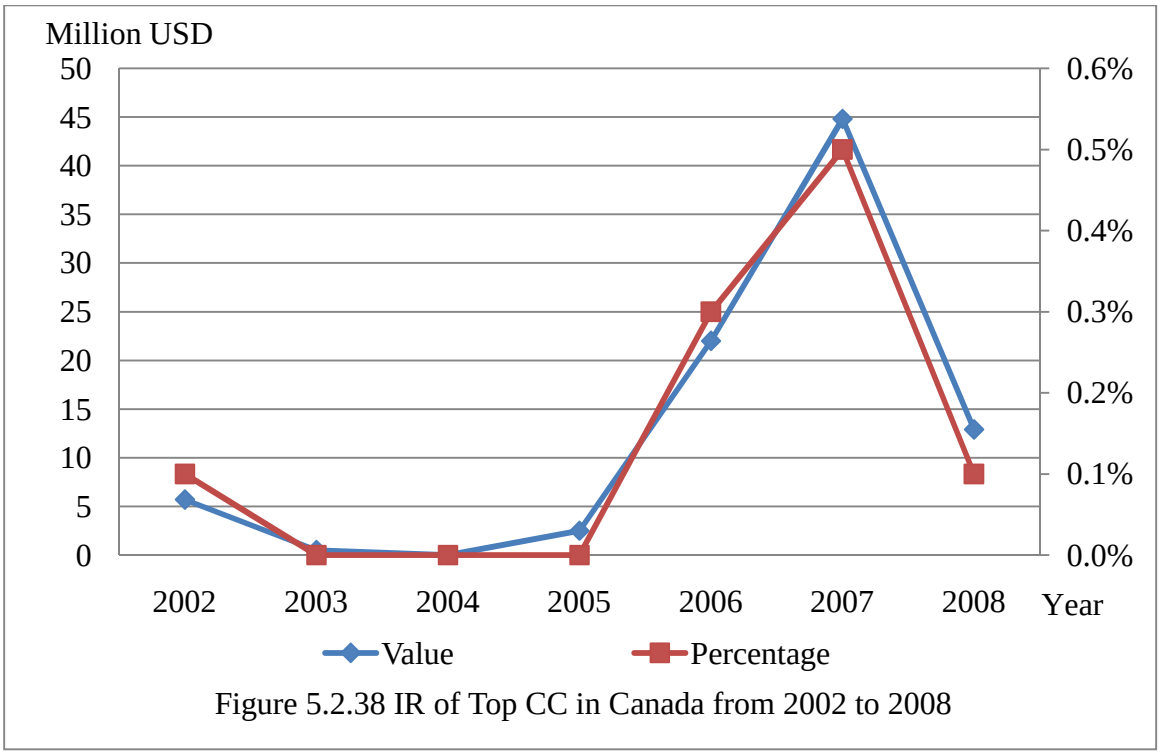

Figure 5.2.38 IR of Top CC in Canada from 2002 to 2008

Note: Left scale shows value; Right scale shows percentage.

5.2.4 Projection

Projections of the future development of the Chinese construction companies in the global market were based on the following assumptions: (1) the growth rates of turnovers or revenues will be similar as current trend and no major global economic recession will happen; (2) political policies in each region, where the projects are located, will remain stable and no military conflicts will occur; (3) enough resources will be available to support the growth of Chinese construction companies; (4) no currency inflation will occur; and (5) structures, such as company scales, number of companies, etc., of Chinese construction industry will not change. Projections of market size, turnovers in regions, and average IR per Top CC were conducted using polynomial functions, which largely matched the growth trend of existing data.

5.2.4.1 Projection of Market Size

Figure 5.2.39 displays the projection of total turnover fulfilled by Chinese construction companies. A cubic polynomial curve can be developed to accurately match the change of total turnover from 1980 to 2008 ($R^2 = 0.9524$). In addition, the curve can be extended to project future growth. The polynomial function is:

$$y = 0.0914x^3 - 2.9381x^2 + 29.521x - 61.411 \quad (5.7)$$

where

x = year

y = total value of turnover fulfilled in 100 million USD.

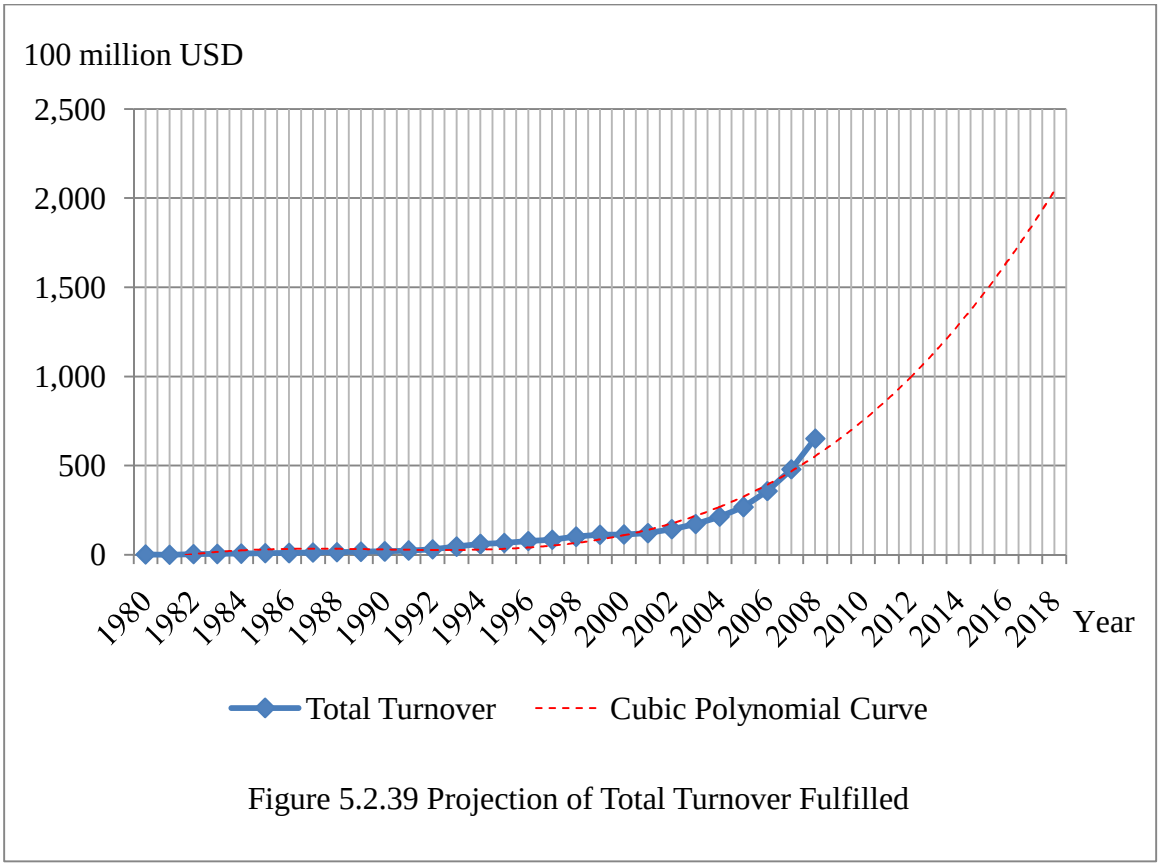

Figure 5.2.39 Projection of Total Turnover Fulfilled

Figure 5.2.40 displays the projection of turnover fulfilled in construction projects for Chinese construction companies. A cubic polynomial curve can be generated to accurately describe the change of turnover fulfilled in construction projects from 1980 to 2008 (R^2 = 0.9467). This curve can be extended to project future growth. The polynomial function is:

$$y = 0.0862x^3 - 2.8457x^2 + 28.502x - 59.508 \quad (5.8)$$

where

x = year

y = turnover fulfilled in construction projects in 100 million USD.

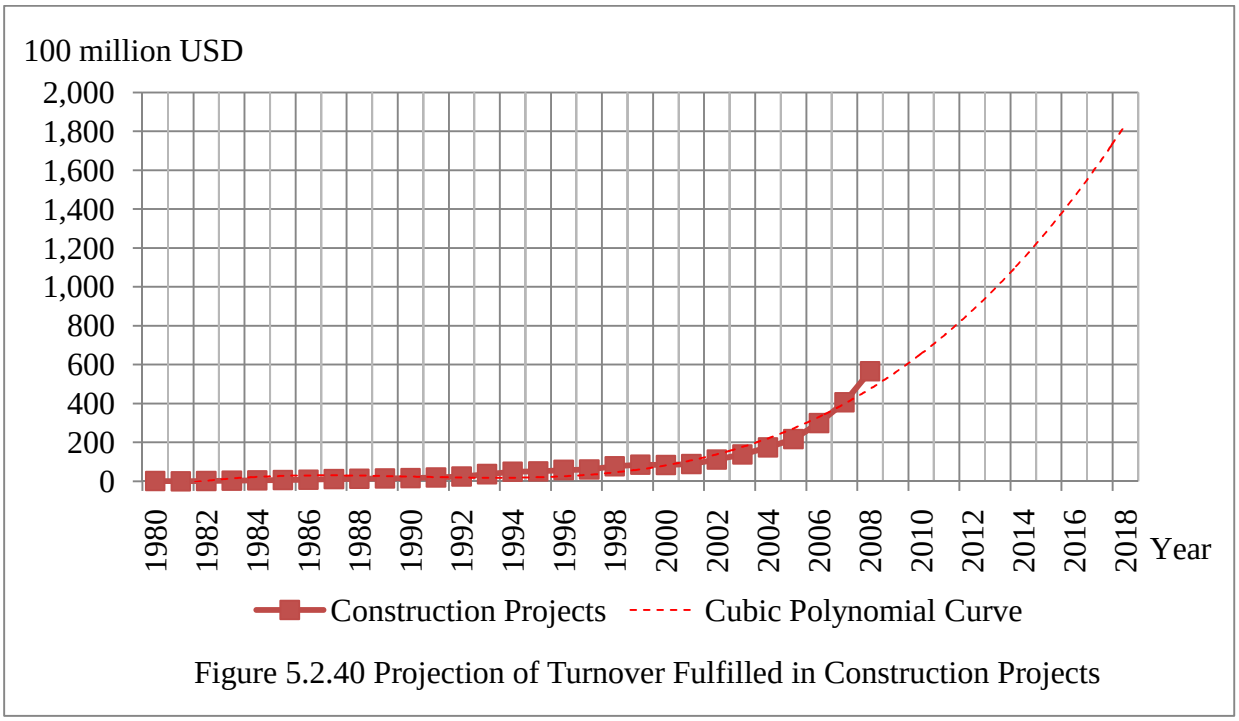

Figure 5.2.40 Projection of Turnover Fulfilled in Construction Projects

Figure 5.2.41 displays the projection of turnover fulfilled in labor services for Chinese construction companies. A quadratic polynomial function can be developed to represent the turnover fulfilled in labor services (R^2 = 0.9668). This curve can be utilized to project future growth. The polynomial function is:

$$y = 0.1335x^2 - 1.7046x + 5.4243 \quad (5.9)$$

where

x = year

y = turnover fulfilled in labor services in 100 million USD.

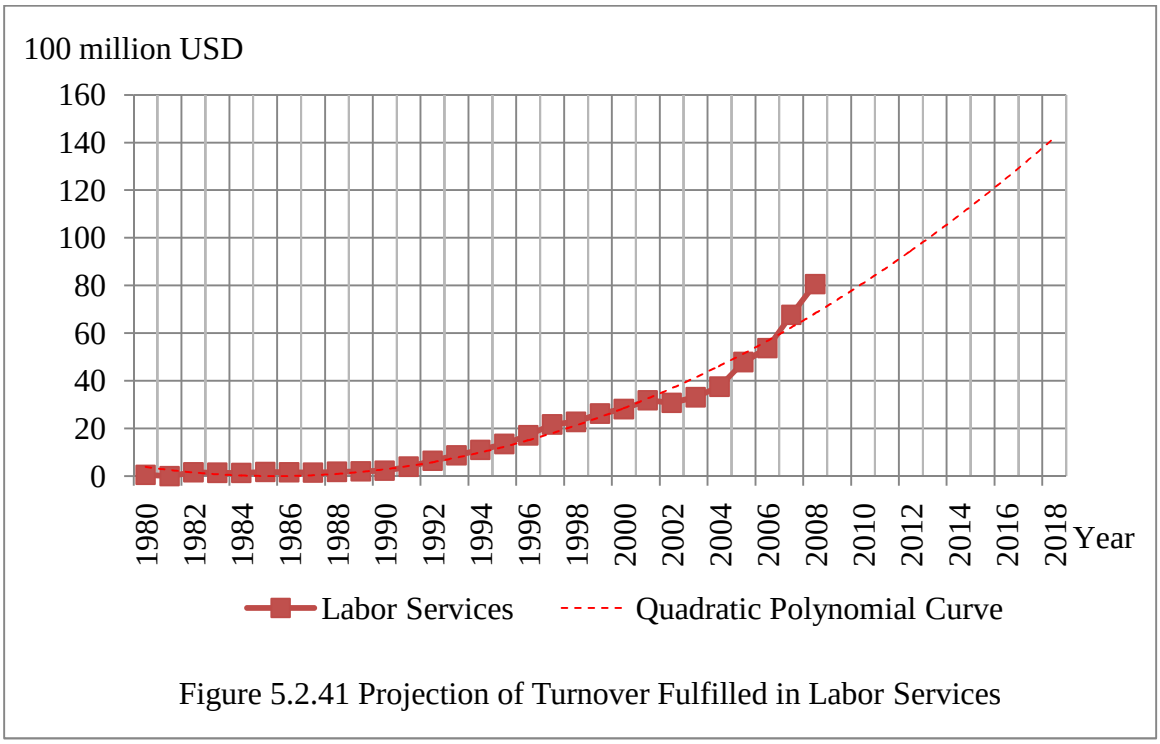

Figure 5.2.41 Projection of Turnover Fulfilled in Labor Services

Figure 5.2.42 displays the projection of turnover fulfilled in design consultation for Chinese construction companies. A quadratic polynomial function can be developed to represent the turnover fulfilled in design consultation ($R^2 = 0.8793$). This curve can be extended to project future growth. The polynomial function is:

$$y = 0.0589x^2 - 0.6606x + 2.5925 \quad (5.10)$$

where

x = year

y = turnover fulfilled in design consultation in 100 million USD.

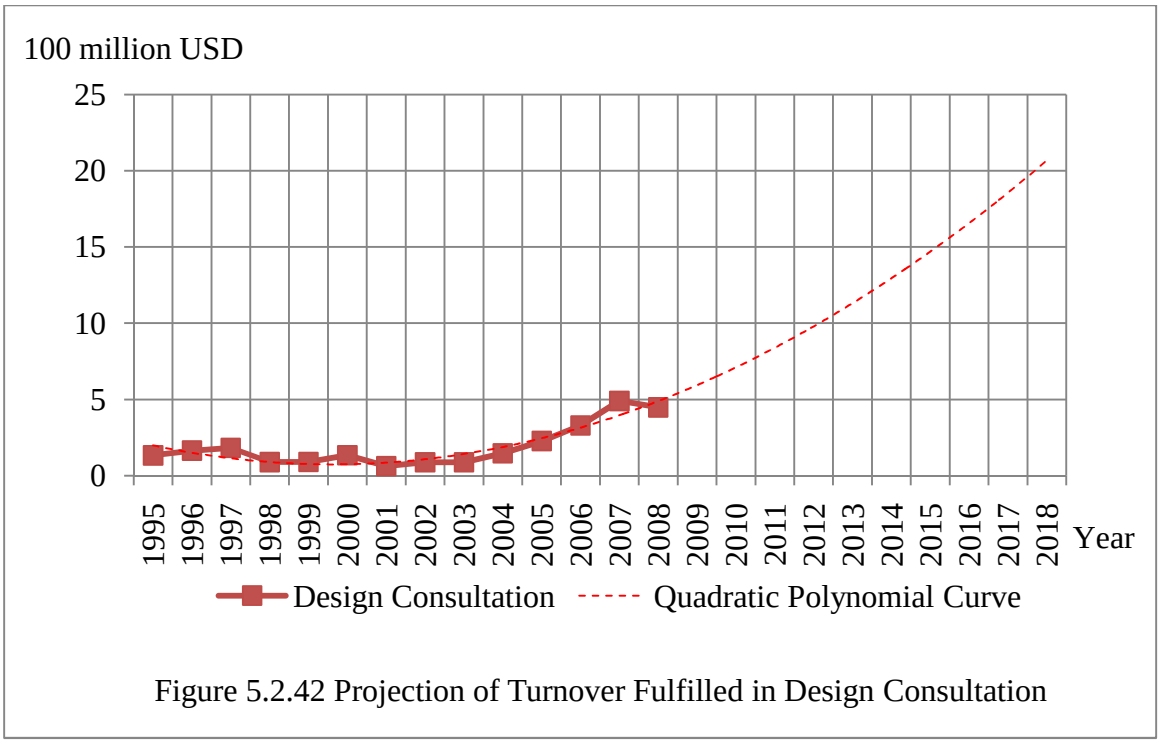

Figure 5.2.42 Projection of Turnover Fulfilled in Design Consultation

5.2.4.2 Projection of Regions

Figure 5.2.43 displays the projection of the total turnover fulfilled by Chinese construction companies in Asia. A cubic polynomial curve (with $R^2 = 0.9959$) can be used to accurately match the growth of turnover in Asia from 1998 to 2008. The extension of the curve can be utilized to project the future growth. The polynomial function is:

$$y = 5440.7x^3 - 53743x^2 + 180817x + 501659 \quad (5.11)$$

where

x = year

y = turnover in Asia in million USD.

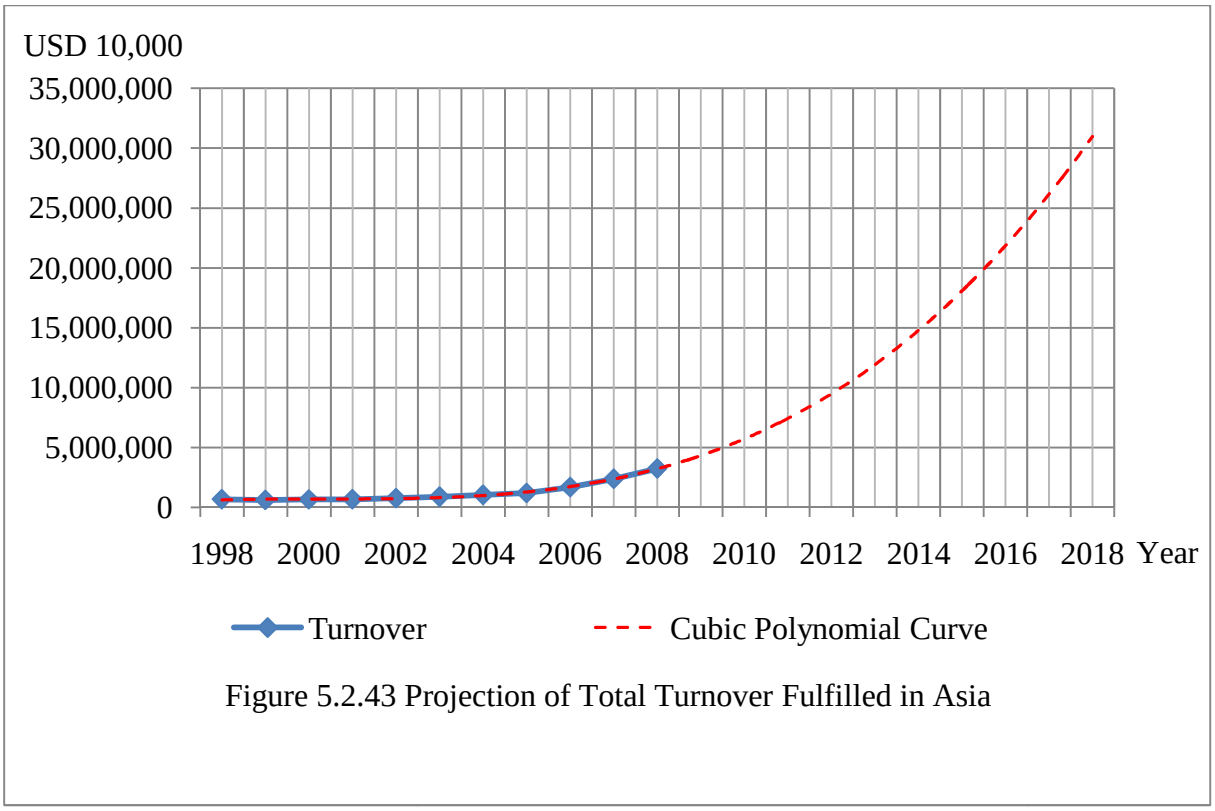

Figure 5.2.43 Projection of Total Turnover Fulfilled in Asia

Figure 5.2.44 displays the projection of the total turnover fulfilled by Chinese construction companies in Africa. A cubic polynomial curve (with $R^2 = 0.9951$) can be used to accurately match the growth of turnover in Africa from 1998 to 2008. The curve can be extended to project future growth. The polynomial function is:

$$y = 3199.7x^3 - 25141x^2 + 52685x + 160482 \quad (5.12)$$

where

x = year

y = turnover in Africa in million USD.

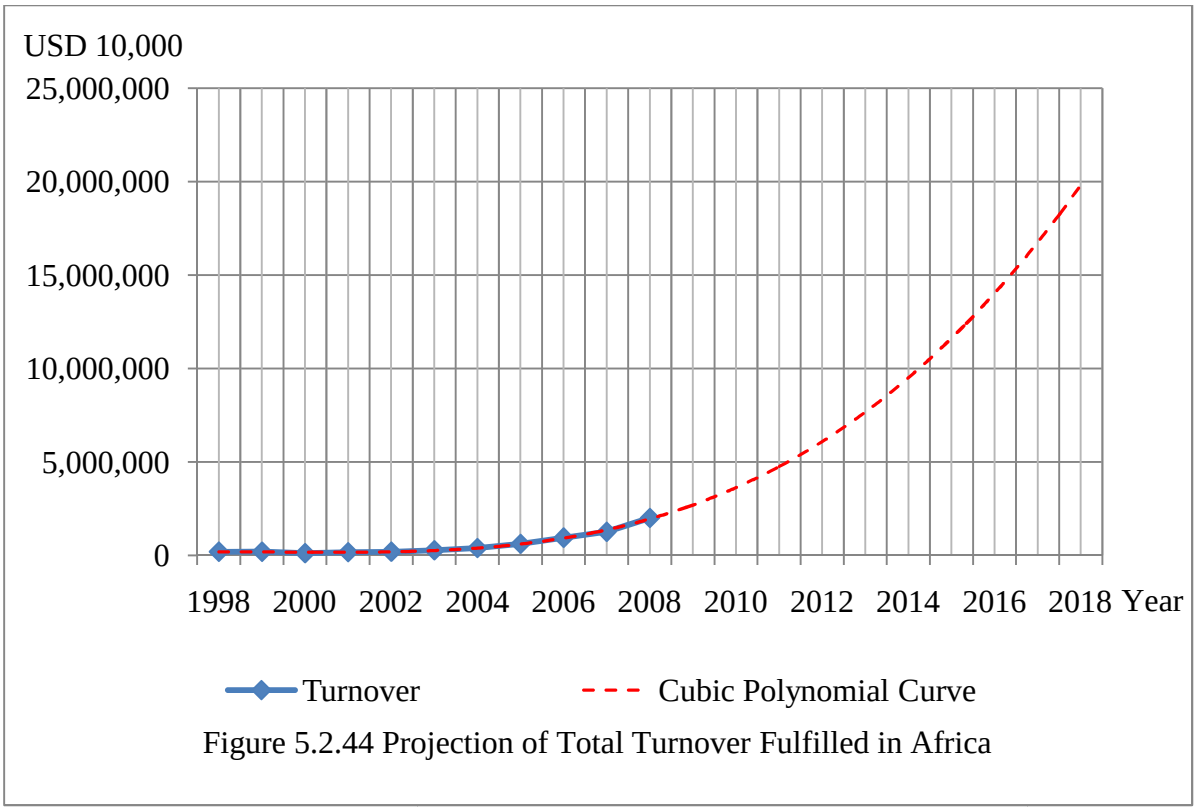

Figure 5.2.44 Projection of Total Turnover Fulfilled in Africa

5.2.4.3 Projection of Top CC's IR

Figure 5.2.45 displays the projection of average IR per Top 225 and per Top CC. The cubic polynomial curves can be developed to accurately match the growth of average IR per Top 225 and per Top CC from 2002 to 2008. The polynomial function of average IR per Top 225 (R^2 = 0.9955) is:

$$y = 5.7037x^3 - 36.734x^2 + 173.53x + 378.09 \quad (5.13)$$

where

x = year

y = average IR per Top 225 in million USD.

The polynomial function of average IR per Top CC ($R^2 = 0.9889$) is:

$$y = 7.7402x^3 - 60.313x^2 + 156.14x + 55.263 \quad (5.14)$$

where

x = year

y = average IR per Top CC in million USD.

With the current growth rates and using the two polynomial functions 5.13 and 5.14, it was projected that the average IR per Top CC will surpass that of Top 225 by about 400 million USD in 2015.

On the other hand, based on Equation 5.14, the projected average IR per Top CC in 2018 will be 23,306 million USD. If the number of Top CC keeps the same of 50 as that in 2008, the total IR for 50 Top CC will be 1,165 billion (50*23,306 million) USD in 2018. As for Top 225, based on the average growth rate of IR per year from 2002 to 2008, which was 22.3%, the total IR for Top 225 in 2018 will be 2,920 billion USD. Thus, in 2018 Top CC will account for about 40% of total IR fulfilled by Top 225, which is possible.

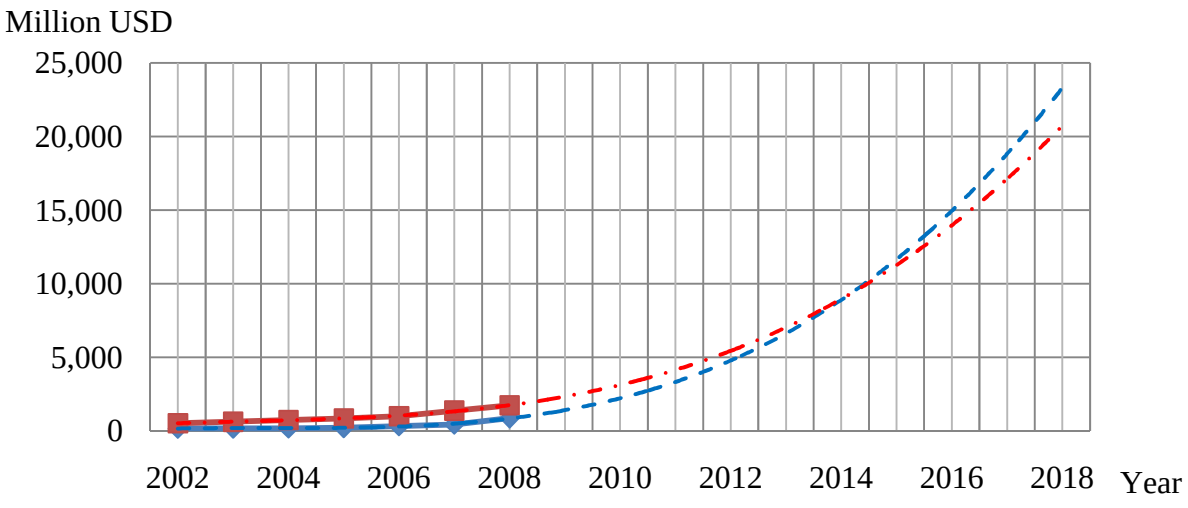

Figure 5.2.45 Projection of Average IR per Contractor

5.2.5 Summary

After the accession to the WTO, Chinese construction companies continued to exploit the global market. By the end of 2008, the contract number of overseas projects was more than 160,000, increased by 4.7 times; the contracting value reached 113 billion USD, increased by 5.3 times; and the turnover surpassed 65 billion USD, increased by 3.5 times compared with the numbers in 2002. In terms of the average annual turnover per contract, the construction projects were the largest of all, between 2 and 11 million USD per contract; while the labor services were the smallest, between 0.04 and 0.1 million USD per contract. Although the total volume of design consultation was insignificant compared with the other two sectors, in 2007 its average annual turnover per contract was more than 20 times of that of labor services.

During this period, Asia was still the largest market for Chinese contractors. Turnover in this market was about 50% of the total turnover in average. Africa, as the second largest market,

the percentage of turnovers increased most in this period, from 14.1% to 30.9% at an average growth rate of 14% per year. Besides, in the market of Latin America and Oceanic & Pacific Islands, the percentages of turnovers also rose in this period. However, in the markets of Europe and North America, the percentages of turnovers declined.

As for the performance of TOP CC from 2002 to 2008, their turnovers increased in all 7 regions. The number of Chinese firms in ENR Top 225 International Contractors reached 50 in 2008, the most in the world. Furthermore, the growth rate of Top CC's IR, the percentage of Top CC's IR in Top 225 and the average IR per Top CC all increased dramatically in this period.

In terms of the turnover fulfilled, projections using polynomial functions suggest that all three types of Chinese overseas projects (construction projects, labor services and design consultation) will continue to increase in the future. Chinese market share of total turnover in Asia and Africa, which are the largest markets for Chinese construction companies, will also continue to rise. In addition, based on the growth rate of IR, the average IR per Top CC is projected to surpass the average IR per Top 225 by about 400 million USD in 2015, according to the results of polynomial functions.

Chapter 6

Conclusions and Recommendations

Chinese construction companies have made great achievements in global market since China adopted the open-door policies in 1978. The growth of market values, regional shares and the performance of the Top CC from 1979 to 2008 were presented in Chapter 5. Based on the results of data analyses, future projections of Chinese construction companies in the global market were also analyzed. Based on the findings, conclusions and recommendations are presented in this chapter.

6.1 Conclusions

6.1.1 The Expansion from 1979 to 2001

This research has produced several conclusions for the expansion of Chinese construction companies from 1979 to 2001. These conclusions are described as follows.

1. Chinese construction companies expanded their market all over the world (more than 180 countries or regions).

2. The market size was increasing steadily in all aspects: the contract number of overseas projects increased by about 900 times; the contracting value increased by about 300 times; and the turnover increased by about 70 times during this period.

3. In terms of the average turnover per contract, the construction projects undertaken by Chinese contractors grew in most of the years and became the largest of the 3 types of overseas projects (construction projects, labor services and design consultation) in 1983. However the average annual turnover per contract for labor services had a downward trend during this period.

4. Asia was the largest market for Chinese construction companies and the turnover in this market was 72% of the total turnover in average during this period.

5. Africa was the second largest market for Chinese contractors, but the proportion of construction projects with the largest average annual turnover per contract undertaken in Africa was higher than that in Asia.

6. Except Asia and Africa, the market share of Chinese construction companies in other markets was relatively small at less than 11% in average during this period.

6.1.2 The Expansion from 2002 to 2008

This research has also drawn some conclusions for the expansion of Chinese construction companies from 2002 to 2008. These conclusions are as follows.

1. After the accession to the WTO, Chinese construction companies continued to exploit the global market. By the end of 2008, the contract number of overseas projects reached 160,000, increased by 4.7 times; the contracting value reached 113 billion USD, increased by 5.3 times; and the turnover surpassed 65 billion USD, increased by 3.5 times.

2. In terms of the average turnover per contract, the construction projects remained the largest (between 2 and 11 million USD per contract), while the average turnover per labor service was the smallest (between 0.04 and 0.1 million USD per contract). Although the total volume of design consultation was insignificant compared with the other two sectors, in 2007 its average annual turnover per contract was more than 20 times of that of labor services.

3. Asia was still the largest market for Chinese construction companies, although the turnover share dropped a little at about 50% of the total turnover in average during this period.

4. Africa was still the second largest market for Chinese contractors. In addition, the percentage of turnover increased the most in this period, from 14.1% to 30.9% at an average growth rate of 14% per year.

5. Only in Europe and North America, Chinese contractors' overseas contracting business declined in terms of turnover fulfilled.

6. Top CC's turnovers increased in all 7 overseas regions. The number of Top CC in ENR Top 225 reached 50 in 2008, the most in the world. Furthermore, the growth rate of Top CC's IR, the percentage of Top CC's IR in Top 225 and the average IR per Top CC all increased dramatically in this period.

7. In terms of the turnover fulfilled, projections using polynomial functions suggest that all three types of Chinese overseas projects (construction projects, labor services and design consultation) will continue to increase in the future.

8. In addition, based on the growth rate of IR, the average IR per Top CC is projected to surpass the average IR per Top 225 by about 400 million USD in 2015.

6.2 Recommendations

6.2.1 Recommendations for U.S. Construction Companies

U.S. construction companies have one of the richest experiences in the international construction market. Based on ENR yearly reports of the Top 225 International Contractors (Top 225) from 2002 to 2009, several of the largest U.S. construction companies were presently among the strongest international contractors in the world both in terms of their international revenues and international business distributions. On the other hand, as the major competitor, Chinese construction companies have demonstrated different growth path and comparative advantages in

contrast with U.S. companies. The major factors that contributed to their rapid expansion overseas recently include an abundant supply of cheap and skilled manpower from China; their high degree of motivation and adaptability working in different environments; strong government support and financing flexibility; and historical links with developing countries, etc (Low et al. 2004). As a result, with the increasing presence of Chinese contractors on the global stage, U.S. contractors are now being challenged. It is always a good practice for U.S. contractors to know the competitor's performance before adopting new strategies.

However, all the original data from China Statistic Year Book are in Chinese versions which are difficult for U.S. construction professionals to read. This study translated all the collected Chinese-version information into English and analyzed the expansion of Chinese construction companies in the global market in a comprehensive way. As a result, U.S. construction professionals are able to study the weakness and strength of Chinese construction companies and develop strategies to compete with them.

For Chinese construction companies, design consultation was always insignificant. The turnover of design consultation accounted for no more than 2.2% from 1995 to 2001 and 1.0% from 2002 to 2008. After 2008, its turnover can be projected by a polynomial function. Regarding to large construction projects in the global market, it is becoming increasingly important to minimize the project risk for an owner and to reduce the delivery schedule by overlapping the design phase and construction phase of a project. In practice, the method of Design-Build (DB) undertaken by a general contractor has brought many benefits to the owners of various projects. Furthermore, some popular contracting methods such as Build-Operate-Transfer (BOT) or Build-Own-Operate-Transfer (BOOT) have been widely utilized in large public projects, which also require construction companies having design capability. Thus,

considering Chinese contractors' weakness in design consultation, it is a good practice for U.S. construction companies to strengthen their cooperation with U.S. design and engineering firms in the future to improve their competitiveness in the global market.

Chinese construction companies were largely concentrated in their traditional markets of Asia and Africa. From 1998 to 2001, in average, the combination of Asia and Africa was around 73% of total overseas turnovers. According to the performance of Top CC in 2008, their percentage of IR in Top 225 achieved 20.6% in Asia and 42.4% in Africa. As a result, Top CC replaced the European contractors in Top 225 (accounted for 35.7% in 2008) as the largest group of contractors in the African market. With the continuous expansion in Asia and Africa, Chinese contractors have achieved large advantages in these two markets. To maintain the overseas market share, U.S. construction companies should pay more attention on Asian and African markets and find ways to enhance their competitiveness.

On the other hand, after China joined the WTO, Chinese construction market is becoming rapidly internationalized that foreign companies are allowed to set up wholly owned enterprises in China. The profit rate of foreign funded construction companies in 2007 was 7.0% and that of foreign solely owned construction companies even reached 15.8%, much higher than the average profit rate of Chinese construction companies at the level of 3.1% (China Statistical Yearbook 2008). These figures suggest that after China entry into WTO, foreign funded firms have succeeded and gained great profit in the Chinese construction market. Moreover, there is still a considerable technological gap between companies in China and developed countries. Thus, with the technological advantages, this is the right time for U.S. construction companies to enter the current booming Chinese construction market.

6.2.2 Recommendations for Future Research

This research presents the analysis of the global expansion of Chinese construction companies from 1979 to 2008 without considering the problems that these companies were facing or will encounter in the near future. Further study should focus on these topics such as what kinds of problems the Chinese construction companies had encountered during each period and what impacts these problems had brought to; what challenges, such as environmental and safety issues, Chinese companies will be facing in the future expansion if these companies continue to grow at their current tendency; and how these companies will compete against foreign construction companies in the global market. On the other hand, data analysis was conducted in general and limited areas such as contracting value and turnover fulfilled. Thus, analysis on more specific fields is recommended for future study such as quality, productivity, safety, and project management.

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